GUIDELINES FOR THE SCIENTIFIC STUDY OF OIL SPILL EFFECTS

STUDY ELEMENT 9

BIRDS & MARINE MAMMALS

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INTRODUCTION

Since marine birds and mammals are generally the most conspicuous casualties of oil spills, and there are measures that may be taken to reduce impacts on some populations, a rapid and organized scientific response is nearly always required in the event of a major marine or estuarine oil spill. We can think of no higher priority scientific investigation than one that not only collects appropriate data on the movement of oil, but also predicts how that transport may impact large populations of marine birds and mammals. In many situations, the only practical approach of assessing the distribution of populations is a series of aerial surveys at or near the time of the spill. The data from the surveys may be used to create a distribution model that, when integrated with data describing the oil spill trajectory, provides a detailed description of the populations at risk. When an aerial survey is combined with a thorough count of beachcast animals, the uncertainties associated with the consequences of an oil spill can be greatly reduced.

Credible assessment of impacts of oil spills requires both aerial surveys of distribution of marine birds and mammals at sea and a careful search for oiled animals on the shore. These two indispensable elements are addressed in Rationale A, Aerial Surveys for Birds and Marine Mammals, and Rationale B, Beach Surveys for Birds and Marine Mammals. When a spill is small and confined, the magnitude of mortality can be estimated in part by counting dead animals that are deposited on the beach or collected during clean-up of adjacent waters. However, in a large spill many animals may come into contact with oil as it drifts with winds and currents. Some of these are deposited on the beach, but others may sink, decompose, or be scavenged at sea (Hunt 1987; NRC 1985). The longer a carcass remains at sea, the less likely anything identifiable will be recovered on shore.

Bird and mammal surveys may also be needed for significant inland spills although dense riparian vegetation, and sinuous or braided river channels make the aerial surveys more challenging than those offshore.

Hindcast models use the results of aerial surveys, to indicate where concentrations of birds and mammals may have become oiled, together with simulations such as those prepared by NOAA/OR&R (formerly NOAA HAZMAT) or direct observations to describe the path of oil to contaminated beaches. From these data, a time-course of drift of oil and oiled animals in the days following a spill can be constructed. Rate-functions that approximate the loss of oiled birds at sea and on beaches can then be used to estimate the proportion of total mortality represented by oiled animals collected on the beach.

A prerequisite for a defensible estimate of total mortality from large oil spills is a description of the distribution and abundance at sea of marine birds and mammals during or shortly following a spill episode. Necessarily, data are collected by aerial survey so the affected area can be thoroughly

surveyed several times during the episode. Aerial surveys require trained observers, well-rehearsed communication and data collection procedures, and proven aircraft and photographic equipment. Rationale A and the accompanying methods describe in detail how such aerial surveys should be conducted.

Equally important in the days following a spill is a search of affected shoreline and keeping records of beachcast animals. Care must be taken to properly allocate search effort, keep accurate records, and avoid errors caused by volunteers primarily concerned with the rescue of oiled animals. Rationale B and accompanying methods provide guidance on how to collect these data in a scientific manner.

This Study Element should serve solely as a guide for assessing the impact of an oil spill on birds and marine mammals and does not necessarily represent the only way to do this kind of work. The methodology presented here will produce good and valid data, but it may need to be modified depending on specific details of the spill and site. Of course, any modification should be documented if used. These guidelines are not intended to be standards that those who respond to a spill cannot modify if needed; indeed, it may be appropriate to use completely different approaches.

RATIONALES

A. AERIAL SURVEYS FOR BIRDS AND MARINE MAMMALS

Birds and marine mammals are often the most conspicuous casualties of oil spills. Seabirds may be locally abundant, occur in large foraging or resting flocks on the water, and may die in substantial numbers when contacted by oil. In a large spill, hundreds or even thousands of oiled birds may be found on contaminated stretches of beach. From the known habits of the most common oiled species, it is generally accepted that contact with oil occurs at sea and that birds drift with the slick until cast up on the beach (e.g., Hope-Jones et al. 1970). Results of some field studies show that beached birds, both alive and dead, may represent only a fraction of the total numbers of oiled birds, the remainder being lost at sea (Ford et al. 1991a,b; Piatt and Ford 1991). Among marine mammals, sea otters, harbor seals, and fur seals are known to be especially sensitive to oil spills. Potential impacts of oiling on fur seals have been supported by laboratory work (Kooyman et al. 1976); impacts on sea otters have been firmly established by the Exxon Valdez spill. Other marine mammal species, such as dolphins or whales, may be found sick or stranded following an oil spill; however, this may result more from increased beach search effort than oil-related morbidity or mortality.

Marine birds and mammals have a patchy and seasonally variable distribution at sea. As oil slicks pass through these areas, contact with oil may occur. Dead or weakened animals may drift with the oil until they are beachcast. However, a portion of the animals may sink, be decomposed or scavenged, and never be found by searchers. Natural resource damage assessment models attempt to estimate the loss that occurs at sea. To accomplish this it is important to have a detailed description of the distribution of vulnerable seabirds and marine mammals in the area at the time of the spill. The only practical method for describing these animal distributions is by aerial survey subsequent to the occurrence of a spill. Aerial survey data can later be integrated with a representation of the movement of the oil.

A.1 Study Design

Prompt response with aerial surveys is required following an oil spill. If possible, aerial surveys should census or sample bird and mammal populations before or soon after they are contacted by oil. If surveys cannot be carried out during a spill response, they may still be useful for up to a month afterward if most seabird and mammal distributions remain unchanged. The objective of a pre-spill survey is to describe the populations subject to risk, not the population already impacted. Later, after the path of oil is known, the number of potentially oiled birds or mammals can be estimated by a post-spill survey. Details are included in:

Method 9.1 *Aerial Survey Logistics*

Methods call for repeated surveys of the affected area during the days immediately following a spill if logistically feasible. The number of times that areas should be repeatedly surveyed will vary with the situation. In general, if most animals are contained in tight aggregations, overflights should be conducted for several days to determine if these aggregations are stable. If most animals are dispersed, a one-day overflight will be adequate. Repeated surveys for the same area should be made on different days if possible to account for diurnal shifts in distribution. Depending on the extent of contamination, surveys should be conducted over open waters, along the exposed shore, and in bays and estuaries. Data are to be collected by surveys in an area sufficiently large to encompass waters potentially subject to contact by oil. To be useful, the surveys should anticipate the movement of oil and work ahead of the spill. In most circumstances, forecasts of oil slick movement can be obtained from the On-Scene Coordinator (OSC). During the response phase of a spill, such forecasts are prepared on a frequent basis by the NOAA OR&R team and should be easy to obtain.

Aerial surveys should be flown in a high-wing twin engine aircraft. The aircraft should be capable of flying three to four hours at survey speeds (90-100 kt (90-100 M/h)) and have seating for at least three observers. The study design calls for aerial surveys at 200 ft (60 m) above sea level (ASL). The methods vary depending on the habitat to be surveyed. For the appropriate methods for a particular habitat, see:

Method 9.3 *Open Water Bird and Marine Mammal Surveys*,
Method 9.4 *Exposed Shoreline Bird and Marine Mammal Surveys*,
Method 9.5 *Bay, Tidal Wetland, and Estuarine Surveys*.

In bays and estuaries, transects may not be practical and all seabirds, waterfowl, and other animals should be directly counted and photographs taken to verify counts.

Aerial surveys should be coordinated with government agencies. Permits may be required for flight at altitudes less than 1,000 ft (305 m) over some marine sanctuaries and refuges. With permits in hand, conduct of surveys requires only that the appropriate agencies be notified by telephone. Even with permits, every effort must be made to avoid disturbance to birds and marine mammals. The standard 200-foot (60-m) altitude results in little significant disturbance except near colonies or rookeries where breeding is actively underway. Permit requirements are discussed in:

Method 9.6 *Permits*.

Aerial navigation to determine the geographical position of the aircraft and the locations of sightings of birds or mammals is best accomplished by use of an electronic navigation system that inputs directly to an on-board computer. Aerial survey logistics ensure that the survey area is appropriately defined and that survey effort is sufficient to obtain useful results. See the following for assistance with survey logistics and aerial navigation:

Method 9.1 *Aerial Survey Logistics,*
Method 9.2 *Aerial Navigation.*

For bird, mammal, and turtle species known to occur in four regions: (1) Alaska (including a portion of the arctic fauna), (2) British Columbia, Washington, Oregon, and California, (3) the Gulf of Mexico, and (4) the east coast of the United States, see:

Appendix A *Species Checklist.*

A directory of the major suppliers of aircraft services is provided in:

Appendix B *Directory of Aircraft Services.*

Sample data forms that may be adapted for use on aerial surveys are provided as Form 9.*1–Bird and Marine Mammal Aerial Survey Variables and Codes*, Form 9.2–*Marine Mammal Aerial Survey Data Form*, and Form 9.3–*Bird Aerial Survey Data Form.*

A.2 Field Sampling

Data collected are single sightings of individual animals or groups of animals. They are collected along with time and the geographical position. In general, observers attempt to conduct a "strip census" through habitat used by birds and marine mammals. This approach is identical to that used on surveys done by the Minerals Management Service for birds and consists of a thorough search of a narrow corridor along the aircraft track line.

Numbers of birds are sufficiently great to allow estimates of abundance to be calculated from a count of all birds within a narrow search corridor. However, marine mammals are less common and therefore reliable estimates of abundance are more difficult to obtain. On prior survey projects by the Minerals Management Service and the National Marine Fisheries Service, marine mammals have been surveyed using an unbounded corridor (i.e., searched to the horizon). This results in more sightings, but not necessarily improved density estimates. An analysis of data collected on MMS-OCS surveys shows that most sightings of marine mammals were recorded in the nearest 100 m to the track line. The proportion of marine mammals observed within this strip, as a percentage of the total, varies according to the size and coloration of marine mammals and their group size; ranging from 57% for large light-colored Risso's dolphins, to 63% from smaller Dall's porpoises, to 70% for Pacific white-sided dolphins, and to 73% for California sea lions (from data presented in Green et al. 1992; Bonnell and Ford 1987). It is apparent that much complexity can be eliminated by using a strip census approach to data collection. The field sampling plan for marine mammals therefore recommends a thorough search of a 100-m corridor, and that only sightings within this corridor be used in estimates of density. For details see:

Method 9.3 *Open Water Bird and Marine Mammal Surveys,*
Method 9.4 *Exposed Shoreline Bird and Marine Mammal Surveys,*
Method 9.5 *Bay, Tidal Wetland, and Estuarine Surveys.*

B. BEACH SURVEYS FOR BIRDS AND MARINE MAMMALS

Beached animals typically form the basis of estimates of spill related mortality. Under most circumstances, only a fraction of the dead animals become beached and only a fraction of the beached animals can be recovered. The total mortality must be estimated from this subsample. It is therefore important that data be collected in a way that is scientifically defensible so that estimates of total mortality can be as accurate as possible. Typically, much of the search effort is provided by volunteers and state and local agencies. Volunteers in particular are prone to concentrating on live injured animals and frequently fail to collect information relating to the recovery of animals that have already died. Under these conditions, it may not be possible to exert significant control over much of the data collection process. It is nonetheless possible to provide recommendations to groups involved in the beached animal recovery process, to ensure that the search effort is carried out in a scientific manner. Even if all beaches cannot be searched in a systematic fashion, estimates of the rate at which dead and injured animals were beached on carefully searched beaches can later be used to estimate the rate in areas which were not systematically searched or where data were not regularly recorded.

B.1 Study Design

Coordination with government agencies and community groups is necessary in conducting surveys for beached birds and mammals after an oil spill incident. Conducting searches for beached birds and mammals and recording the results in a scientifically defensible manner requires the allocation of search effort, beached animal retrieval, and analysis of retrieved specimens and recorded data. For coordination with government agencies and other parties, see:

Method 9.7 *Beached Animal Survey Coordination.*

The distribution of beached animals typically follows the distribution of beached oil, as does the timing of the arrival of beached animals. The most basic strategy for allocating search effort is to concentrate on those beaches where oil has been reported. Whenever possible, beached animal search efforts should occur prior to the arrival of cleanup crews since these crews historically may place oiled animal carcasses with oiled debris and remove them without recording their presence. Animal carcasses typically begin arriving along with the beached oil. The arrival rate usually peaks over a period of one to three days, but may taper off over a period of a week or more. Depending on the substrate, carcasses persist on the beach face for varying lengths of time, but in many situations significant numbers (on the order of 50% or more) may be scavenged or removed on a daily basis.

Note that not all beached animals are oiled, and recoveries of unoiled beached animals may later be of considerable use in separating oil spill related mortality from natural mortality. The determination of natural mortality in beached carcasses that subsequently become oiled is difficult to make, and may require subsequent autopsy or oil typing. An exception to the pattern of the concurrent arrival of oil and beached animals may occur when injured but active seabirds come ashore. Another set of circumstances in which the arrival of floating oil and beached animals do not coincide may occur when the spilled oil dissipates more rapidly than the animal carcasses sink. Details on the spatial and temporal allocation of search effort are included in:

Method 9.8 *Allocation of Search Effort for Beached Birds and Mammals.*

B.2 Field Sampling

Once a search effort strategy has been determined, appropriate beaches should be searched systematically; careful records should be kept of both search effort and animals retrieved. Details are included in:

Method 9.9 *Beached Animal Retrieval.*

B.3 Laboratory Procedures

Retrieved animals should be examined at collection centers for verification of species identification, counts, degrees of oiling and decomposition, etc. Details are included in:

Method 9.10 *Beached Carcass Analysis.*

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Method 9.1
AERIAL SURVEY LOGISTICS AND PLANNING

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1.0 PURPOSE

This method is for determining (1) the duration of surveys, (2) the extent of the area to be surveyed, and (3) the amount and allocation of survey effort. Surveys should be initiated as soon as possible after an oil spill occurs, and continue on a frequent basis as oil drifts through an area occupied by marine birds and mammals. The surveys should encompass the entire area where impacts could occur or to where animals might relocate.

The primary purpose of aerial surveys is to determine the distribution of birds and mammals in the affected area. Survey effort should be adequate to obtain an acceptable population estimate for each of the most abundant species that might be contacted as oil drifts through the area.

2.0 DEFINITIONS AND CONVERSION FACTORS

Cetaceans—Marine mammals such as whales and dolphins which are fishlike in appearance except that the tail fluke is horizontal, not vertical. The large whales usually are not seen at close range unless washed up on a beach.

Gulls—Conspicuous seabirds that swim and feed at the water surface and are mostly found near shore.

Pinnipeds—Marine mammals (e.g., seals & sea lions) with front and hind limbs developed into flippers. They are usually seen only along shores, although they may go far out to sea when in migration (Burt and Grossenheider 1976).

Seabirds—Those species whose normal habitat and food source is the sea, whether they are coastal, offshore, or pelagic (Harrison 1983).

Shorebirds—Wading or swimming birds, most of which feed along shores, though a few feed inland (Robbins et al. 1983).

Tubenoses—Seabirds with external tubular nostrils such as petrels, shearwaters, and albatrosses. These birds range far offshore and come ashore on remote islands and shores only to breed.

Waterfowl—Aquatic birds with webs between the three front toes such as ducks and geese. These birds are usually found nearshore or in bays and estuaries (Robbins et al. 1983).

Oil Volume

Tons (U.S.) = 2,000 lbs
Tons (U.S.) x 0.907 = Tons (metric)
Tons (metric) x 1.102 = Tons (U.S.)
Tons (U.S.) x 294 = Gallons (Average Oil)
Gallons / 42 = Barrels (bbls)

Distance

Kilometers (km) x 0.5396 = Nautical miles
Nautical miles (M) x 1 = Minutes of latitude
Nautical miles x 1.1516 = Statute miles
Statute miles x 1.852 = Kilometers (km)
Meters (m) x 3.281 = Feet
Feet (ft) x 0.3048 = Meters

Speed

Knots (kt) = Nautical miles/hour
Knots x 1.852 = Kilometers/hour

3.0 EQUIPMENT

1. NOAA Nautical Charts (at least 1:200,000, preferably greater resolution; Mercator Projection).
2. Dividers, Rule.
3. Weather radio (i.e., radio tuned to NOAA weather station printed on NOAA Nautical Chart).
4. Tide tables (obtain locally).

4.0 PROCEDURES

4.1 Timing and location of Aerial Surveys

The timing and layout of aerial transect lines will be determined by logistic as well as scientific considerations. Constraints imposed by weather, aircraft availability, and crew availability will limit the amount of aerial survey work that can be accomplished. It is imperative that survey time be allocated efficiently and that priorities be set so that the most important data are collected first.

4.1.1 Initiation of aerial transects

Ideally, aerial survey work should start within 24 hours following the beginning of an oil spill. However, delays in the determination of the seriousness of a spill, making arrangements with biologists qualified to carry out aerial surveys, and obtaining suitable aircraft are all factors that frequently delay the onset of surveys. These delays can be significantly reduced by the use of standing arrangements with biologists and aircraft suppliers.

Although it is best to survey just before or after an area is affected by oil, this is frequently not possible. On a scale of miles, distributions of seabirds, shorebirds, and marine mammals are usually stable for periods from several weeks to a month

or more. The exception to this is during periods of migration or where large numbers of animals form feeding aggregations at ephemeral food sources. The following guidelines are general and should be used in consultation with biologists familiar with the local fauna: it is not possible to provide specific guidance for all possible circumstances. Note that the stability of animal distributions is species specific, and that while a two-week lag between the beginning of a spill and the onset of aerial survey may be unacceptable for one species, it may be completely acceptable for another. The time spans shown in Table 9.1-1 are the delay between the beginning of the oil spill and the onset of aerial surveys:

Table 9.1-1. Expected consequences in survey value at various delays from onset of spill.

Delay	Consequences
1 to 3 days:	Surveys should reflect very closely the actual distribution of animals at the time of the spill.
3 to 7 days:	Surveys should still closely reflect the actual distribution of animals at the time of the spill. If ephemeral feeding aggregations are present, they may have shifted during this period.
7 to 14 days:	Surveys will provide good general characterization of animal distributions regarding features such as average density in nearshore and offshore zones, latitudinal gradients, and the locations of stable foraging areas.
14 to 28 days:	Survey results for some species are likely to be affected by seasonal events such as migration or changes in breeding status. For most species, surveys will still provide useful general characterization of animal distributions regarding features such as average density in nearshore and offshore zones, latitudinal gradients, and the locations of stable foraging areas.
More than 28 days:	Except in special circumstances, survey results are likely to be called into question because of seasonal shifts in distribution. In special cases, it may be possible to utilize historical data or to survey the area at the time of the spill the following year.

4.1.2 Layout of Aerial Survey Tracklines

The allocation of survey effort will depend on the size of the area affected by the oil spill and on the distributional patterns of seabirds and marine mammals in the affected area. If possible, the entire area impacted by the spill should be surveyed. If logistical constraints prevent survey of the entire area, the areas of greatest animal concentration should be surveyed preferentially. If these areas are unknown, then the areas first affected by the spill should be surveyed first.

There are 5 categories of habitat that may need to be surveyed:

1. Bays and Estuaries—Enclosed brackish bodies of water, tidally influenced with freshwater inflow. Bird numbers in these areas are highly variable due to the arrival and departure of large flocks of gulls, shorebirds, and waterfowl with

changes in the tidal state. Pinnipeds, particularly harbor seals may be abundant at haulout sites.

2. Surf Zone—Extending from the beginning of the surf line seaward about 100 meters. Seabirds and waterfowl tend to congregate, sometimes in very large numbers, along this line. Aggregations tend to be more stable in this zone than in bays and estuaries, varying on a scale of days or weeks.

3. Nearshore Zone—Extending from the Surf Zone to about 5,000 meters seaward. Seabirds and marine mammals tend to be more evenly distributed in this zone than in the Surf Zone and in bays and estuaries. Large feeding aggregations sometimes form and disperse over a period of hours and certain areas will consistently have higher densities than other areas.

4. Shelf Zone—Extending from the seaward edge of the Nearshore Zone to the edge of the continental shelf at about the 200-meter depth line. This area is similar to the Nearshore Zone, but typically is more homogeneous and animals are present in lower densities than nearer shore. Nonetheless, large numbers of animals may be present in this area, and in some spills such as the *Apex Houston* (Page, Carter, and Ford 1992), the *Puerto Rican* (Dobbin et al. 1986), and the *Exxon Valdez* (Ford et al. 1996), most of the injury to seabirds occurred within this zone.

5. Offshore Zone—Extending seaward from the edge of the continental shelf at about the 200-m depth line. This area is usually characterized by low densities of animals and is utilized by a relatively small number of species.

Areas where the oil slick has passed or is expected to pass need to be surveyed. In most spills, the area ultimately affected tends to be larger than the area considered to initially be at risk. It is better to err in the direction of surveying a larger area than a smaller area. For most spills occurring nearshore, the Shelf Zone and the Offshore Zone will not require surveying. If the oil slick moves offshore, the spill occurred offshore, or a leaking vessel is to be towed offshore, the Shelf Zone should also be surveyed. There are few instances where surveying beyond the edge of the continental shelf will be necessary.

An efficient general strategy for surveying these zones is to sample bays and estuaries and the Surf Zone on the first pass along the shoreline, and then to make a return pass using a zig-zag or sawtooth pattern. The teeth of the sawtooth pattern should be about 5,000 m at the base along the Surf Zone, and extend seaward to an apex at about 5,000 m offshore. If the Shelf Zone or Offshore Zones are to be surveyed, some of these teeth can be extended seaward to the 200-m depth line or beyond. This survey design allows all zones to be surveyed with little or no wasted aircraft time, and for the aircraft to return to its original base of operations at the end of the survey.

Survey replication is desirable when logistic constraints permit. Up to three replicates of the survey trackline are useful: more replicates usually add little new information unless the spill incident lasts more than 2 to 3 weeks. This assessment

is subjective, but is based on our experience in analyzing aerial survey data from a number of spill incidents.

4.2 Extent of Survey Area.

At a minimum, the survey area should encompass waters that have been or might be oiled by a spill. The ultimate extent of contamination may not be known at the time surveys begin. Thus, some judgment must be used as to the direction of movement and the potential area of contact. The best source of information about the area likely to be affected by the oil slick is usually available from the incident command. If information is not available from this source, the following guidelines are useful:

4.2.1 Estimate the direction of movement of oil slicks

Oil slicks drift with surface currents. During prolonged periods of calm, persistent long-shore currents become expressed at the surface. During periods of wind, floating oil will move in the direction of prevailing winds at about 2-4% of wind speed. In most seasons, winds off the coast are sufficiently strong to provide a good indication of the direction in which oil will drift.

In bays, tides become an important consideration. Tidal currents are greatest in the central channel of bays; oil caught there will generally move toward the mouth of the bay on an ebb tide, then reverse and move deeper into the bay on the flood tide. As oil spreads into shallow waters, winds become a more significant influence on oil movement.

Information on winds can be obtained by telephoning the NOAA National Weather Service (NWS) or using a Weather Radio tuned to the NWS frequency. (The broadcast frequencies for NOAA VHF-FM weather stations in the affected area are printed on most NOAA charts.) Information on local winds can also be obtained by contacting any airport or harbor. Especially in the winter and spring as a result of changing wind direction, reversals may occur in the direction of oil movement during a spill event. Additionally, current directions can change once or twice a day in estuaries as a result of tides. Thus, do not limit the initial survey area only to the initial downwind direction.

4.2.2 Estimate the size of the contaminated area

The spill volume is a significant variable, but it may not be known with certainty at the time surveys begin. Thus, it may be necessary to estimate volume that could potentially be released (e.g., the capacity of ruptured compartments of a tanker). This information can be obtained from the vessel operator or other industry source. The time in days that oil is acted upon by wind and waves must also be estimated. Generally, large spills (10,000 to 100,000 bbl) require at least 7-14 days to spread to their full extent (Ford 1985). In the discussion below, 10 days is used as a basis for estimating the size of the area of oil spill slick.

From the analysis of historical data, regression equations were calculated to estimate extent of contamination as a function of spill volume and time (Ford 1985). To estimate the area of contamination on the water, the regression equation is:

$$\log(AREA) = -0.8163 + 0.5735 \log(VOL) + 1.3139 \log(DAYS)$$

Where area is measured in square km, and volume is measured in bbl. In historical spills, this equation explained 83.5% of the variance.

Using a 10-day period for oil to spread, this equation becomes:

$$\log(AREA) = 0.5735 \log(VOL) + 0.5$$

The length of coastline contacted can also be determined statistically. However, there is more scatter in data on affected coastline than for size of oil slicks on the water. A regression analysis of the data examined explained 58.6 % of the variance.

To obtain a rough estimate of the length of potentially affected coastline, use the regression equation:

$$\log(COAST) = -0.4046 + 0.476 \log(VOL)$$

where coast is length of coastline contacted in km and volume is the spill volume in bbl.

5.0 QUALITY ASSURANCE/QUALITY CONTROL

None.

6.0 DATA PROCESSING

None.

7.0 DELIVERABLES/REPORTING

None.

8.0 HEALTH & SAFETY CONSIDERATIONS

Although the aircraft supplier and pilot may be familiar with airport facilities near the survey area, the survey team leader should not rely on it. In planning a survey, the time to complete transects, and the time for commuting to and from fuel sources must be estimated. The range of the aircraft depends on throttle settings. Many aircraft are less efficient at survey speeds than at faster cruising speeds. Therefore, consult the pilot to determine whether 90 kt is a safe speed for transect work. Determine the safe range of the aircraft allowing for fuel for at least one-hour reserve. This range should be known and not exceeded. It is also important to identify secondary airports and emergency landing strips that can be used if the primary airport cannot be reached or is closed down by weather.

9.0 PERSONNEL

Role of personnel on aerial surveys is described in Method 9.2. Determination of aerial survey logistics is the responsibility of the survey team-leader. Familiarity with navigation and operation of the aircraft is desirable but not essential.

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Method 9.2
AERIAL NAVIGATION

Revision No.: 0
Revision Date: July 9, 1999
Prepared by: Michael Bonnell, Compass-Rose Marine Research
Glenn Ford, R.G. Ford Consulting Company
Prepared for Petroleum Environmental Research Forum (PERF), Project 94-10

1.0 PURPOSE

This method is for obtaining and using data on the position of the aircraft. These data are essential for mapping the distribution of marine bird and mammal sightings, and calculating search effort along the transect line (see also Method 9.3–*Open Water Bird and Marine Mammal Surveys*).

Aerial navigation serves two functions: (1) it ensures that the position of the aircraft on survey is known with sufficient precision to allow pre-established transect lines to be followed and replicated, and (2) it provides the position of the aircraft at the instant each bird or mammal sighting is recorded. No clear definition of, "sufficient precision" exists, but on past surveys, following transect lines within about 0.1 minute of latitude or longitude (about 600 ft [185 m]) over the open water has been adequate. A higher degree of precision, on the order of 50 to 100 m, is desirable for mapping the distribution of bird and mammals, especially in waters where the densities are great or in semi-enclosed bays, estuaries, or archipelagoes.

Piloting an aircraft along a transect line requires use of an electronic navigation system. With a simple system, the pilot flies the aircraft according to information provided by the digital display of the navigation system. With a more complex system involving a navigation computer, the pilot programs the system to fly the aircraft between pre-defined latitude-longitude positions (way-points). Aerial navigation is the responsibility of the pilot and varies with the equipment aboard the aircraft. No method is provided here for aerial navigation along transect lines.

The survey team has different needs. The position of the aircraft should be entered automatically into an on-board computer every 10 seconds or less. The survey team must be prepared to work on short notice with a variety of aircraft in different locales (see Method 9.1–*Aerial Survey Logistics and Planning*). For this reason, the recommended method is to arrive on-site with a stand-alone system appropriate to the needs of data entry.

2.0 DEFINITIONS

GPS—Global Positioning System for determining the position of an aircraft or ship by receiving and processing signals from several earth-orbiting satellites. GPS is potentially accurate to about 0.01 km, however the finest resolution is reserved for military applications, through selective availability (S/A) imposed by the Department of Defense. Using Standard Positioning Service (SPS), precision is about 50 m to 100 m; with Differential GPS corrections, it is possible to reduce the error induced by S/A to 10 m or less. In general, the accuracy provided by SPS is sufficient for this application.

Loran-C—Long-range navigation system using pulsed signals received from pairs of land stations. Loran-C is locally precise to about 1% of the distance of the receiver from the transmitters (depending on locale and distance from shore, on the order of 1.0 km).

VLF-Omega—Global navigation system for determining the position of an aircraft or ship from very low frequency (VLF) signals received from two or more land stations; VLF-Omega is precise to 0.1 km or less, but may be blocked by terrain.

3.0 EQUIPMENT

For safe and effective operation over the water, the survey aircraft must be equipped with an electronic navigation system. Loran-C, VLF-Omega, or GPS are all acceptable for navigation of aerial transect lines. Loran-C and VLF-Omega are more likely to lose contact with a transmitting station than GPS. When this occurs, the navigation system cannot determine the aircraft's position. Because GPS is in contact with more stations (in Puget Sound, for example, typically 5-7 satellites), and the signals are not blocked by topography, the system can more reliably obtain a position fix. In some regions, land stations are being phased out and GPS will increasingly be the system of choice.

A survey team may have to work with a variety of different aircraft in different locales. All will be able to adequately navigate transect lines with Loran-C, VLF, or GPS and, given sufficient lead-time, could also provide an interface with the survey team's data-logging computer. However, to avoid any delays, the scientific team should use a transportable, platform-independent GPS receiver. This approach also permits the entire system of receiver/processor, computer, and software to be engineered to work reliably wherever surveys need to be conducted. Such a system has been developed for the State of Washington, Department of Wildlife, and for the U. S. Fish and Wildlife Service, and consists of:

1. GPS Receiver/processor with display.

2. External antenna and coaxial cable.

3. External power supply for computer and/or 12V adapter to connect to aircraft power supply.

4. Data-logging computer and appropriate cables for connecting the computer and GPS receiver.

5. Software for continuous logging of time, position, and transect status capable of at least 5,000 data records.

Additional equipment is listed in Method 9.3–*Open Water Bird and Marine Mammal Surveys*.

4.0 PROCEDURES

4.1 Installation of equipment

All aircraft identified in the Aircraft Services Directory (Appendix B) will have an electronic navigation system installed and ready for use. In many instances, this will be a Loran-C. It is highly recommended that the survey team arrive on-site with a portable GPS receiver along with a data-logging computer. An external GPS antenna, preferably with at least an 8-inch lead and a suction cup mount, is necessary for this application. The antenna can be attached to the aircraft windscreen, overhead bubble, or side windows. Unless the data logging software and computer have been tested beforehand with the aircraft navigation system, it is strongly recommended that the survey team carry its own navigation equipment.

5.0 QUALITY ASSURANCE/QUALITY CONTROL

The position of the aircraft as indicated by the electronic navigation system can be checked against known landmarks. Beyond that, there is little that can be done to verify the accuracy of the system. If a transportable GPS is aboard (as described above), it can be used to substantiate the reading of the aircraft navigation system. It is also important to have NOAA charts of the area that will be surveyed (Mercator Projection, approximately 1:200,000). For coastal surveys, these charts can be used to identify landmarks that can then be named on voice tapes to monitor progress and verify the position entered from the GPS. Most of the role of navigation charts or map-boards is obviated by a data-logging computer. However, should the navigation electronics go off-line for any reason, and the computer not receive input on position, the approximate locations stated on the voice-tapes become essential to mapping the distribution of sightings on shoreline surveys along the open coast. Offshore surveys should not be conducted without an electronic navigation system.

6.0 DATA PROCESSING

With use of a data-logging computer, the position of the aircraft should be written to disk every 5 to 10 seconds (about 300 m - 600 m along the track line). A sample aerial trackline based on GPS fixes recorded at 5-second intervals is shown in Figure 9.2-1. In the absence of a data-logging computer, data on time/position of transect turn-points can be recorded manually or on audio tape and entered into a computer at the completion of the survey.

7.0 DELIVERABLES/REPORTING

The member of the scientific team serving as a data-recorder must note time off-the-ground, start/stop times on transect, and location of turns, time and location of break from transect (e.g., to take a closer look at a sighting), time back on the transect, and time on-the-ground. Notes may be taken in pencil on paper or recorded on pre-printed forms (e.g., Form 9.2– *Marine mammal Aerial Survey Data Form*) using the species and count fields to record the nature of the change in status. Precise monitoring of progress down the trackline is typically provided by the data-logging computer from input from the GPS. Following the survey, a report should be prepared that provides an itinerary and a map of the transect lines.

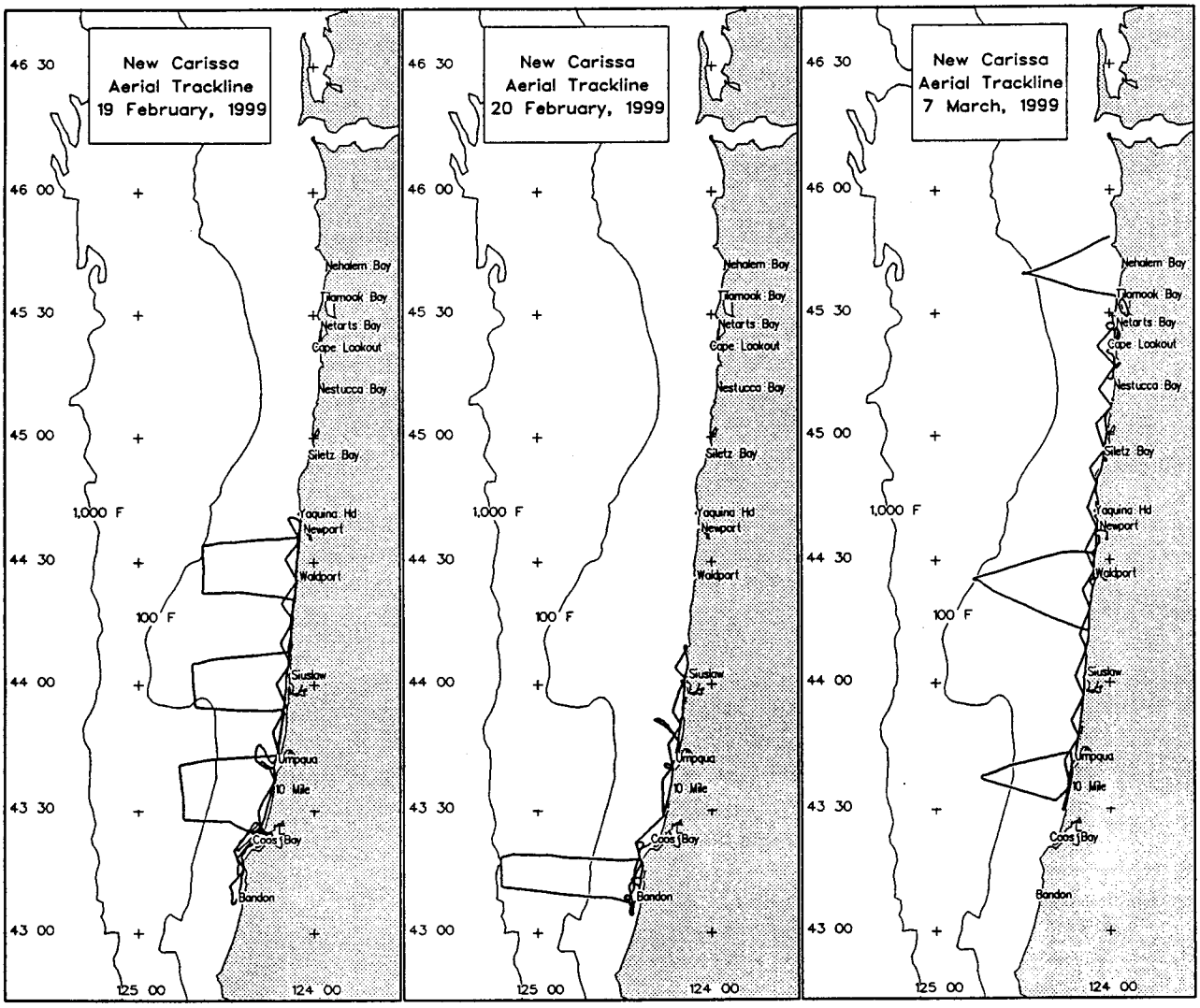

Figure 9.2-1. Aerial trackline from the *New Carissa* oil spill off the coast of southern Oregon (winter 1999). The trackline is based on GPS fixes recorded at 5-second intervals. The Feb. 19 and Feb. 20 tracklines are for offshore and bay surveys. The sawtooth pattern flown on Mar. 7 exemplifies a trackline for a nearshore survey.

8.0 HEALTH & SAFETY CONSIDERATIONS

It is essential that a detailed flight plan be filed prior to take-off. The flight plan should include, at a minimum, the latitude and longitude boundaries of the area to be surveyed. The pilots should request flight-following, if available, and periodically inform the Flight Service Station by radio of the aircraft's position and any changes in the flight plan. Pilots are responsible for avoiding Restricted Areas, and obtaining authorization for flight within Warning Areas. Surveys may be conducted only under VFR conditions (Visual Flight Rules). The scientific crew should assist the pilots by freely communicating any observed hazards in the air (e.g., other aircraft) and on the water (e.g., small islands or ships).

9.0 PERSONNEL

Aerial navigation for safe operation of the aircraft is the responsibility of the pilots. However, the scientific crew may assist by providing additional information on location, the name of landmarks, coordinates of waypoints, headings, or a more precise position of the aircraft. Aerial navigation to avoid disturbance to biologically sensitive areas is the responsibility of the team-leader of the scientific crew (see Method 9.6 for discussion of sensitive resources and permits).

10.0 REFERENCE DOCUMENTS

Method 9.1 Aerial Survey Logistics
Method 9.3 Open Water Bird and Marine Mammal Surveys

Method 9.3
OPEN WATER BIRD AND MARINE MAMMAL SURVEYS

Revision No.: 0
Revision Date: July 9, 1999
Prepared by: Michael Bonnell, Compass-Rose Marine Research
Glenn Ford, R.G. Ford Consulting Company
Prepared for Petroleum Environmental Research Forum (PERF), Project 94-10

1.0 PURPOSE

This method is for conducting aerial surveys of birds and marine mammals in open waters potentially affected by an oil spill (see Method 9.1–Aerial *Survey Logistics and Planning*, Section 4.1.2 - Nearshore Zone, Shelf Zone, and Offshore Zone). The purpose of the surveys is to obtain a detailed description of the distribution of each species. To accomplish this, sightings and positions are recorded along transect lines that are arranged to sample animal abundance and distribution in the area potentially affected by an oil spill (Briggs et al. 1985). Data are collected along the transect and the position of each sighting is recorded using a data-logging computer and Global Positioning System receiver (see Method 9.2). Density is determined from the count of individuals in a fixed-width search corridor for any portion of the transect. This protocol is applicable to nearshore, shelf, and offshore habitat.

2.0 DEFINITIONS

None.

3.0 EQUIPMENT

Equipment Checklist (see also equipment lists for Method 9.1–*Aerial Survey Logistics and Planning* and Method 9.2–*Aerial Navigation*):

1. Clinometers (2), Suunto (Finland) or equivalent.
2. Tape Recorders (2), with pause or on-off microphones.
3. Cassette Tapes (60 min. or more per side).
4. Batteries for tape recorders (AA alkaline).
5. Digital watches.
6. Scientific calculator.
7. Clipboard.
8. Pencils.
9. Data Forms (see below).
10. Binoculars (7x or higher magnification).
11. Field Guides.
12. 35-mm SLR Camera(s).
13. 80-200 mm or 75-300 mm telephoto zoom lens.
14. 200 ISO Kodachrome or 200 to 400 ISO Ektachrome film.

Safety Equipment (NOT optional):

1. 6-person raft, self-inflating, attached by lanyard to aircraft; recent U. S. Coast Guard inspection certificate.
2. Survival (Immersion) suits, USCG approved, if surveys are to be conducted in northern or arctic waters.
3. Emergency Locator Transmitter (EPIRB), tested.

4.0 PROCEDURES

The distribution and abundance of both birds and marine mammals can be mapped on the same aerial surveys. Birds will be far more abundant than marine mammals and are typically the most conspicuous casualties of oil spills. From this standpoint, it is reasonable that the structure of the surveys should be weighted toward the requirements of marine birds rather than marine mammals. The principal difference in methodology is the width of the search corridor. The use of both bird and mammal observers requires an aircraft such as a DeHavilland Twin Otter that can seat at least five passengers including four observers. Two dedicated marine mammal observers may be used if this type of aircraft is available. Planes of this size are rarely available, and most surveys will be conducted using two observers and a computer operator. In these cases, the seabird survey protocol (see Section 4.1.2) should be used and bird observers should record all mammal sightings along with bird sightings.

Surveys should be flown at 200 ft (60 m) above sea level (ASL) and at 90 kt ground speed. This allows most birds to be identified to the species level under good light and sea conditions. Larger birds and marine mammals are easily identified at this altitude and speed. The detection time is about 2 seconds close to the trackline, and increases outward to more than 5 seconds at 400 m.

Seabird and marine mammal observers should also describe the boundaries of oil slicks to the extent that they are recognizable from the air. The method is to mark the time/position on each transect at which the aircraft encounters an oil slick and the time/position when the aircraft again passes over clear waters.

Before leaving the ground, observers should synchronize watches with the data-logging computer. Ask the pilot to obtain correct time over the radio from the airport traffic control. This is important, because time is used to assign each sighting a geographical position (see Section 6.0).

After conducting the *survey logistics and planning* described in Method 9.1, the following procedures are performed using the *navigation* tools described in Method 9.2.

4.1 Data Collection

4.1.1 General

The computer operator should assist the pilot in navigation along the transect line if the pilot is not flying according to waypoints pre-programmed into the flight computer. The computer operator should make a paper record of the time and position of the following:

1. Takeoff and landing.
2. Endpoints of straight lines on the survey track such as at the base and apex of a sawtooth flight pattern.
3. When observers go on or off duty due to glare, observation conditions, etc.
4. Changes in glare, sea state, or observer conditions.
5. Changes in survey altitude.
6. Changes in survey protocol such as when entering or leaving bays or estuaries.

4.1.2 Birds

Bird sightings are collected by one or two observers, searching a 50-m strip of water along one or both sides of the aircraft. Within this narrow strip, the observer must attempt to record all birds present (i.e., a "strip census"). Sightings are recorded orally on cassette tape along with the time read from a digital watch. Except for glancing at the watch, the observer does not take his or her eyes off the water, and continuously searches a corridor bounded on the inner edge by a line from the observer's eye along the aircraft's fuselage and at the outer edge by marks or masking tape indicating 50-m right-angle distance in level flight. The marks will vary from observer to observer depending on their size and posture. The search corridor bounds can be defined using a clinometer and simple trigonometric functions. Observers should continue recording data unless the glare free portion of their field of view drops below 50%, when sea state reaches Beaufort 5 or above, or when the visibility code reaches the "MO" state (see Tables 9.3-1 to 9.3-3).

To determine the bounds, use a clinometer to define the declination of the inner angle (i.e., the bottom of the window), and the relationship:

altitude (m) / tangent of angle = horizontal distance from trackline

Add 50 m to distance from trackline and solve for the angle as in the following example:

altitude = 60 m (known)
angle of inner boundary = 75 degrees (measured)
tangent of 75 degrees = 3.73

Inner bound: 60 m / 3.73 = 16 m
(this is the right-angle distance blocked by the fuselage of the aircraft)

Angle defining outer bound of 50-m search corridor:

50 m + 16 m = 66 m
60 m / 66 m = 0.91 = arc tangent of 42 degrees

Sight through clinometer and mark 42 degrees declination on the window.

Table 9.3-1. Codes for visibility conditions for observing birds and marine mammals.

Category	Code	Sea State	Observation Conditions
Excellent	EX	1	Surface of water calm with little or no sun glare (often with high overcast sky).
Very Good	VG	2	May be light ripple on ocean surface or slightly uneven lighting; still relatively easy to identify birds or mammals at a distance.
Good	GO	3	May be light chop, occasional whitecaps, some sun glare or shadows in part of observation area. Most marine mammals within 400 m can be detected and identified; no difficulty identifying birds in 50-m search corridor.
Fair	FA	4	Choppy waves with whitecaps, or sun glare reduces observation area by 50%. Most marine mammals within 400 m can be sighted, but identification to species-level more difficult; unlikely to consistently observe marine mammals farther than 400 m. No difficulty identifying birds within 50-m search corridor; some difficulty beyond.
Poor	PO	5	Marginal conditions for sighting marine mammals, with winds in excess of 16 kt (16 M/h) and waves of 2-4 ft with whitecaps and/or sun glare may reduce observation area by 50%. Only marine mammals within 100 m can be reliably identified. Birds in the air within 50 m can be identified, but it is difficult to identify birds on the water.
Mammals Off	MO	6 or greater	Unacceptable conditions for surveys of marine mammals; mammal observers off-watch. Bird surveys may continue due to narrow search corridor. Winds in excess of 22 kt (22 M/h) with many whitecaps or tumbling waves, or sun glare nearly 100% of observation area. Detection of any marine mammal unlikely unless by chance; identification of marine mammals to species-level difficult or impossible.

Table 9.3-2. Codes for sea state.

Beaufort Scale	Appearance of Sea	Wave Height	Wind Speed
0	Smooth and mirror-like.	0 ft	0 - 1 kt
1	Scale-like ripples, no foam crests.	1	1 - 3
2	Small, short wavelets. Crests appear glassy and not breaking.	2	4 - 6
3	Large wavelets. Some crests breaking, occasional white foam crests with glassy appearance.	3	7 - 10
4	Small waves become longer. Frequent white foam crests.	4	11 - 16
5	Moderate waves more pronounced and long in form. Many white foam crests, with some spray off tops.	6	17 - 21
6	Large waves formed, with extensive white foam crests and spray.	10	22 - 27
7	Sea heaves and white foam is blown in streaks.	14	28 - 33

Table 9.3-3. Codes for glare.

Glare Code	Code Meaning
0	No glare.
1	01 - 10%
2	11 - 25%
3	26 - 50%
4	51 - 75%
5	76 - 100%
X	End of glare (as might occur when aircraft passes under clouds)

Sightings of birds beyond the 50-m search corridor may be included on the voice tape to help characterize the bird fauna, but it should always be stated that the sighting is "off-transect." This is because only those within the bounds of the 50-m corridor can be used to estimate density and these sightings must be written into a separate data file for analysis.

Bird sightings should be fully described on the voice-tape, including:

1. Time
2. Species
3. Number within strip census bounds
4. Behavior at time of first sighting (flying, resting, feeding)
5. Associations with other species, prey, oil, flotsam, etc.

The following checks should be performed to avoid data loss:

1. Play-back of last records about every half hour. If tape is garbled or unreadable due to weak batteries, change batteries and re-survey as necessary.

2. Check tape during lulls in bird density to ensure that tape is available on the cassette and that tape is advancing properly. Replace tape or batteries as required.

Depending on the relative composition of the fauna, the time of day, and other viewing conditions, most bird species can be readily identified by an experienced observer. Problems in identification may occur with particular species at particular times of year. Particularly difficult to identify are small alcids, immature gulls, cormorants, scoters on the water, loons in non-breeding plumage, and shearwaters with dark dorsal plumage. The method is to record identifications to the lowest taxonomic level of which the observer is certain. Thus, small, dark diving birds might be recorded as "Rhinoceros Auklets" when characteristic plumage was visible or as "small alcids, "unidentified alcids," or "unknown diving bird" depending on the degree of certainty. A checklist of bird species that can occur in coastal and offshore waters of Alaska (including the Gulf of Alaska), the Pacific states and British Columbia, the Gulf of Mexico, and the Atlantic coast is provided in Appendix A. A complete list of field data and data codes is provided in Form 9.1–*Bird and Marine Mammal Aerial Survey Variables and Codes*.

There are no specific guidebooks for surveys of birds from an aircraft. Use the Peterson Field Guides or other field guides (See References in Appendix A) for the area of interest and identify birds to the lowest practical taxonomic level. Local expertise is valuable in identifying species; therefore, attempt to enlist the aid of ornithologists that live or work in the area in which surveys may be conducted.

4.1.3 Mammals

Because marine mammals are less abundant than birds, greater effort is required to obtain a sufficient number of sightings to map distribution and estimate the population. This can be accomplished by searching a wider strip than is used for birds. Therefore, two dedicated marine mammal observers should be used if the size of the aircraft and crew permits. It is assumed that birds and mammal surveys are being

carried out concurrently and that the aircraft is flying at an altitude (200 ft (60 m)) appropriate for both kinds of survey (Briggs et al. 1992).

Marine mammal surveys typically search to the horizon to obtain the maximum number of sightings. Because observation efficiency declines with distance from the trackline, complex statistics are required to estimate density. To avoid these difficulties, this method calls for a strict strip-census of waters within 100 m, along both sides of the aircraft, with additional search outward toward the horizon. It is essential that all marine mammals within the 100-m search corridor be recorded, providing a minimum estimate of the density of each species. (This is a minimum estimate because some marine mammals are underwater when the aircraft passes and will not be seen; correction factors exist for only a few species.)

Calculation of the bounds of a 100-m search corridor is the same as that described above for bird data. The method for recording sightings of marine mammals is the same as that for birds (Sec. 4.1.1). Observers should record time, species, declination of sighting at right-angle to the trackline, counts of total numbers and numbers within the 100-m corridor, and note behavior, direction of movement, and associations with other species. Dedicated marine mammal observers, if present, should record data on Form 9.2–*Marine Mammal Aerial Survey Data Form* or equivalent.

From time to time, it may be necessary to leave the transect and circle marine mammals to verify the identification and counts. Any circling of marine mammals should be done at 500 ft (152 m) ASL or higher to avoid harassment. The pilot is then instructed to climb to at least 500 ft (152 m) ASL before circling back to reacquire the sighting. Photographs using a 35-mm SLR camera can be made at this point in order to confirm sightings (hand-held video cameras do not have sufficient resolution for this application). Any additional sightings recorded during an excursion from the line must be noted as "off-transect" in the data file.

Observers should record data under excellent to fair viewing conditions and sea state of 0-4 (see Tables 9.3-1 to 9.3-3).

The Leatherwood et al. (1982) guide can be useful in identifying marine mammals:

5.0 QUALITY ASSURANCE/QUALITY CONTROL

Data can be lost by equipment malfunctions or human error. The most common problems on past survey projects have been that data on bird sightings are lost after a tape runs-out, or that low battery voltage affects the sound quality. These can easily be avoided with the simple equipment-check procedures outlined above. Computer malfunctions can occur but never have in over 1,000 hours of survey work. The risk does not warrant carrying a back-up computer. Also, data can be recorded by hand if necessary. A written record of the start and stop time, the position of transects, or the times and locations where observation conditions change makes it possible to reconstruct the trackline of the aircraft in the event that the data-logging system fails.

The most straightforward and rapid means to verify data is to map it into a Geographical Information System (GIS) and examine the distribution of sightings relative to the known

position of the aircraft; an error in position is readily apparent and the record can be identified and corrected.

6.0 DATA PROCESSING

Following the survey, sightings of animals made on audio tapes must be entered into a database format using software such as FoxPro, Access, or Excel. See Forms 9.1, 9.2, and 9.3 (*Bird and Marine Mammal Aerial Survey Variables and Codes,* and *Marine Mammal* and *Bird Aerial Survey Data Forms*) for a list of the fields that should be entered. These sighting records initially will not include positions that must be calculated using the time of the sighting and the known flight track. Sighting positions are calculated by linearly interpolating between sequential fixes along the flight track assuming constant speed and heading of the aircraft. For example, the position of a sighting recorded at time *t* and bracketed by position/time fixes at time 1 and time 2 would be calculated as follows:

$$Lat\_t = (d\_1t / d\_12) * (Lat\_2 - Lat\_1) + Lat\_1$$

$$Lon\_t = (d\_1t / d\_12) * (Lon\_2 - Lon\text{-}1) + Lon\_1$$

Where

d_lt = number of seconds elapsed between the sighting at time *t* and the previous position fix at time 1

d_l2 = number of seconds elapsed between time 1 and time 2

Lat_1 = Latitude of aircraft at time 1 expressed in decimal degrees (for example 37 degrees, 30 minutes, 0 seconds north latitude would be 37.50 decimal degrees)

Lon_1 = Longitude of aircraft at time 1 expressed in decimal degrees

Lat_2 = Latitude of aircraft at time 2 expressed in decimal degrees

Lon_2 = Longitude of aircraft at time 2 expressed in decimal degrees

Lat_*t* = Latitude of aircraft at time *t* expressed in decimal degrees

Lon_*t* = Longitude of aircraft at time *t* expressed in decimal degrees

To our knowledge, the only commercial source of software for this purpose is the R.G. Ford Consulting Company. Alternatively, the interpolation procedure above can be programmed in any language appropriate to the data entry format.

There are several styles in which the survey results can be presented. The simplest tabular form is to divide the survey trackline into segments based on habitat type (i.e. nearshore, shelf, pelagic, etc.) and measure (1) the length of the survey trackline within each habitat type, and (2) count the number of individuals seen within each habitat type. GIS software may be useful in this context. Within each habitat type, density is calculated as follows:

$$D = n / (LW)$$

Where

L = Length of trackline in kilometers
W = Width of strip transect in kilometers (doubled if there are two observers working simultaneously)
n = Number of sightings
D = Density of animals per kilometer squared

A more complex form of analysis involves carrying out these computations for each block on a rectangular grid. Appropriate grid sizes vary from 1 to 5 minutes of latitude and longitude in size (there are 1,852 meters in a minute of latitude). Five minute blocks tend to be appropriate for study areas several hundred miles on a side: 1 minute blocks would be appropriate for study areas 10 or 20 miles on a side or within confined regions such as San Francisco Bay or Puget Sound.

Densities of animals per square kilometer within bays and estuaries can be estimated by dividing the number of animals observed within the area (assuming an exhaustive survey protocol was used; see Method 9.5–*Bay, Tidal Wetland, and Estuarine Surveys*), by the size of the bay in square kilometers.

7.0 DELIVERABLES/REPORTING

A survey report should be prepared which contains at least the following:

1. Brief description of observed fauna.
2. Description of the location and extent of study area.
3. Times and dates of transect lines.
4. Map showing location of transect lines.
5. Map showing locations of sightings of animals.
6. Tabular or graphical representation of densities within relevant habitats or regions.

8.0 HEALTH & SAFETY CONSIDERATIONS

Ditching at sea is unlikely using a twin-engine aircraft (see Appendix B). However, some requirements are imposed by this method to promote survival of the crew should ditching occur. Principle among these is flight-following (i.e., radar tracking of the position of aircraft), if available, or at least frequent updates by the pilot by radio on the position of the aircraft and status of the mission (see Method 9.2–*Aerial Navigation*). Should the aircraft go down, a life raft is essential, and "survival suits" desirable. An EPIRB (Emergency Locator Transmitter) will allow the U. S. Coast Guard to home-in on the crew's position.

Survival suits postpone hypothermia; they are difficult to work in, but should be worn in the aircraft at least over the legs and lower torso on surveys offshore in waters off northern California, Oregon, Washington, the Gulf of Alaska, and other waters farther north. In central California, suits are optional, and off southern California and in the Gulf of Mexico, they may not be needed as long as a life raft is available.

The self-inflating raft should be attached by a lanyard to the aircraft. Thus, it can be tossed overboard. When the aircraft sinks, the raft will automatically inflate. It will quickly drift

away unless held by a crew member, thus it should be carried out of the aircraft by the crew person nearest the door. The EPIRB should be attached to the raft. Crew should be briefed before departure on the duties of each in the event of ditching at sea. Briefing should be done by the pilot(s), with assistance from the leader of the scientific team.

9.0 PERSONNEL

Most individuals who have worked from a ship or onshore with a variety of seabirds and waterfowl, or with marine mammals, will soon be able to assume the duties of aerial observer. In major mapping projects conducted in the past, training programs have been used to ensure that observers are available to rotate into the duty-roster on surveys. The training consists of serving as back-up observer on surveys, sitting on the same side of the aircraft as the primary observer, linked with an intercom system so that the trainee hears all that the on-watch observer is recording onto tape. After the trainee feels comfortable in the role of back-up observer, positions are traded. Still, an experienced observer should assist the new observer by asking "Did you see that?" "What did you call that?" Generally, only a few transect lines are necessary before the trainee is familiar with the species present.

10.0 REFERENCE DOCUMENTS AND CITATIONS

10.1 Literature

Briggs, K.T., W.B. Tyler, and D.B. Lewis. 1985. Aerial surveys for seabirds: Methodological experiments. J. Wildl. Manage. 49:414-419.

Briggs, K.T., D.H. Varoujean, W.A. Williams, R.G. Ford, M.L. Bonnell, and J.L. Casey. 1992. Seabirds of the Oregon and Washington OCS, 1989-1990. Chapter 3: *in* J.J. Brueggeman (ed.), Oregon and Washington Marine Mammal and Seabird Surveys. Final Report prepared for the Minerals Management Service, U.S. Department of the Interior, by Ebasco Environmental, Bellevue, WA, and Ecological Consulting, Inc., Portland, OR.

Leatherwood. S., R. R. Reeves, W. F. Perrin, and W. E. Evans. 1982. Whales, dolphins, and porpoises of the eastern North Pacific and adjacent arctic waters: A guide to their identification. NOAA Technical Report NMFS Circular 444. U. S. Dept. of Commerce, NOAA, NMFS.

10.2 Methods

Method 9.1 Aerial Survey Logistics
Method 9.2 Aerial Navigation

Method 9.4
EXPOSED SHORELINE BIRD AND MARINE MAMMAL SURVEYS

Revision No.: 0
Revision Date: July 9, 1999
Prepared by: Michael Bonnell, Compass-Rose Marine Research
Glenn Ford, R.G. Ford Consulting Company
Prepared for Petroleum Environmental Research Forum (PERF), Project 94-10

1.0 PURPOSE

This method is for aerial surveys of the coastline and adjacent nearshore waters (see Method 9.1, Section 4.1.2 - Surf Zone). Exposed coastline surveys should be done as part of a single survey series that also includes transects over *open water* (Method 9.3) and *in bays, tidal wetlands, and estuaries* (Method 9.5). Most of the methods are similar; however, special precautions must be taken to avoid disturbance to bird and pinniped colonies. Pilots may also encounter restricted areas that must not be entered, and portions of the coast (e.g., National Marine Sanctuaries) where the altitude of flight must be greater than that used farther offshore.

2.0 DEFINITIONS

Colony—Sections of coastline, or exposed rocks or islands used by seabirds, especially for breeding.

Exposed shoreline—Open to direct wave action.

Haulout—Sections of coastline, or exposed rocks or islands upon where pinnipeds come ashore.

Rookery—Sections of coastline, or exposed rocks or islands used by pinnipeds, especially for breeding.

3.0 EQUIPMENT

1. NOAA Nautical Charts, Mercator Projection, approximately 1:200,000 scale.
2. Tape Recorders (2), with pause or on-off microphones.
3. Cassette Tapes (60 min. or more per side).
4. Batteries for tape recorders (AA alkaline).
5. Digital watches.
6. Binoculars (7x or higher magnification).
7. 35-mm camera, 80-200 or 75-300 zoom telephoto lens.
8. Kodachrome 200 or Ektachrome 200 or 400 film, 36 exposure.

See also Method 9.3–*Open Water Bird and Marine Mammal Surveys.*

4.0 PROCEDURES

Coastline surveys are flown parallel to the coastline and 60 m to 500 m offshore depending on the width of the surf zone. The optimum altitude is also 200 ft (60 m), as used on open-water transects, but both the altitude and the lateral distance may vary according to the terrain and presence of sensitive resources. The aircraft should avoid flight over land at less than 1,000 ft (305 m).

The portion of coast to be surveyed is that subject to potential impacts from the oil spill. However, this portion of coastline may shift as oil drifts with winds and currents and the portion of the coastline where oil is finally deposited cannot be predicted with precision in advance of impacts. To be safe, overestimate the size of region to be surveyed.

Two observers are used for bird surveys. If the aircraft is less than 100 m from shore, the inboard (landward) observer identifies and counts birds on land, as well as those in the air and on the water. The outboard (seaward) observer searches a 50-m corridor of nearshore waters using the same procedures as along open-water transects. Both observers describe sightings orally on cassette tape, frequently noting the time and known landmarks. The predominant species in nearshore waters are gulls, cormorants, pelicans, loons and grebes, and shorebirds on sandy beaches. The time and aircraft's position will be entered automatically from a Global Positioning System (GPS) receiver into a computer file (see Method 9.2–*Aerial Navigation*).

Only a single outboard observer will be used to collect sightings of marine mammals in the water since marine mammals are difficult to detect within the surf zone. Procedures will be identical to that used on open-water transects, with a search corridor of 100 m as defined by a clinometer and simple trigonometric functions (see Method 9.3–*Open Water Bird and Marine Mammal Surveys*). The predominant species in nearshore waters are bottlenose dolphins (Gulf of Mexico and California), gray whales, harbor porpoise, harbor seals, sea lions, and sea otters. Sightings will be recorded on the same forms as used for open-water transect surveys (Forms 9.1–*Bird and Marine Mammal Aerial Survey Variables and Codes* and 9.2–*Marine Mammal Aerial Survey Data Form*).

Bird colonies and pinniped haulouts along the shore are very sensitive to disturbance from low-level (200 ft [60 m]) overflights. For this reason, these areas should be identified in advance and avoided. Seabird colony atlases have been produced by the USFWS and should be relied upon; there are no similar atlases of pinniped rookeries, but most will be well-known to biologists flying the surveys. Coastline surveys should be used as opportunities to photograph these locations for later analysis. It is imperative that the aircraft remain at least 1,000 ft (305 m) from the colonies to minimize the risk of disturbance. At 200 ft altitude (60 m), the aircraft should maintain a lateral distance of about 1,000 ft (305 m). For photographs taken at about a 45-degree angle, fly no lower than 750 ft (225 m) and maintain a lateral distance of about 750 ft (225 m); this results in a line-of-sight distance of about 1,000 ft (305 m). Look for any sign of reaction by animals to the aircraft, and immediately veer away if birds fly or pinnipeds move toward the water.

Counts of birds and pinnipeds on shore, rocks, or sandbars should be made from photographs to maintain high data quality. In some cases, video cameras may be useful for this purpose, but in most cases their resolution is too poor for accurate censusing of rookeries or colonies.

5.0 QUALITY ASSURANCE/QUALITY CONTROL

See Method 9.3–*Open Water Bird and Marine Mammal Surveys*, Section 5.

6.0 DATA PROCESSING

See Method 9.3, Section 6.

7.0 DELIVERABLES/REPORTING

A survey report should be prepared providing the itinerary, a map of coverage, and describing the observed fauna.

8.0 HEALTH & SAFETY CONSIDERATIONS

Review Method 9.3, Section 8, regarding ditching and safety equipment.

9.0 PERSONNEL

See Method 9.3, Section 9.

10.0 REFERENCE DOCUMENTS

10.1 Literature

USFWS, Seabird Colony Atlases, various regions.

10.2 Methods

Method 9.1	Aerial Survey Logistics
Method 9.2	Aerial Navigation
Method 9.3	Open Water Bird and Marine Mammal Surveys

Method 9.5
BAY, TIDAL WETLAND, AND ESTUARINE SURVEYS

Revision No.: 0
Revision Date: July 9, 1999
Prepared by: Michael Bonnell, Compass-Rose Marine Research
Glenn Ford, R.G. Ford Consulting Company
Prepared for Petroleum Environmental Research Forum (PERF), Project 94-10

1.0 PURPOSE

This method is for mapping bird and marine mammal distribution and estimating populations in bays, estuaries, and tidal wetlands. The methods are similar to those used for open ocean waters and the outer coast; however adjustments must be made due to the terrain and proximity to cities and coastal development. Depending on the size of the area, surveys may include transects to sample abundance in larger open water areas such as Cook Inlet or the Strait of Juan de Fuca (see Method 9.3–*Open Water Bird and Marine Mammal Surveys*). However, this would typically be done only if the entire area could not be censused. In most embayments, an attempt should be made to fully census populations of birds and mammals in a region potentially contacted by oil.

2.0 DEFINITIONS

None.

3.0 EQUIPMENT

See Methods 9.3–*Open Water Bird and Marine Mammal Surveys* and 9.4–*Exposed Shoreline Bird and Marine Mammal Surveys.*

4.0 PROCEDURES

The habitats in bays and wetlands are some of the most important to birds, providing a foraging ground for enormous numbers of migrating waterfowl and shorebirds, and supporting some breeding populations of endangered rails and terns. Populations of marine mammals in bays are usually small and, in U. S. waters, limited to only a few species of pinnipeds, bottlenose dolphins, and harbor porpoise. For harbor seals, mudflats in bays are an important nursery during the spring pupping season. Because of the sensitivity of habitat and the concern that populations might be disturbed, surveys should be flown at an altitude of at least 500 ft (152 m). Some taxonomic detail will unavoidably be lost, especially in regard to small shorebirds. However, the overall numbers and distribution of birds on mudflats and marsh-edges can be described, and waterfowl, gulls, and cormorants on the water can easily be identified. Pinnipeds and small cetaceans can also be readily identified from 500 ft (152 m).

Unlike aerial surveys to sample the population, surveys of bays and wetlands seek to completely census the populations in an area that might by contacted by oil. This can be accomplished by circling the aircraft over a particular area until all birds or mammals have been identified (using binoculars as needed for identification) and counted. There are no

preestablished flightlines or standard distance from shore that can be maintained: search effort will be determined by the scientific crew. When they are certain that they have fully searched one small region of waters and shore, the aircraft moves on to the next. Counts are marked on maps (see Sec. 7, below). Data collection can be formalized by requesting independent counts of animals by observers aboard the aircraft, but generally, the tally of numbers is made by agreement of all observers aboard the aircraft. Photographs can be very useful for later counts and the roll/frame number can be indexed by time to the location of the aircraft.

The aircraft position is known with precision to at least 0.1 km through the use of a Global Positioning System receiver and entered automatically into a computer file (see Method 9.2–*Aerial Navigation*).

As in the instance of a spill off the outer coast, waters and shoreline most likely to be contacted by oil should be surveyed first, and a broader area subject to potential contact surveyed over the duration of the spill incident. If possible, surveys should be initiated prior to extensive spread of oil (see Method 9.1–*Aerial Survey Logistics and Planning*).

5.0 QUALITY ASSURANCE/QUALITY CONTROL

See Method 9.3–*Open Water Bird and Marine Mammal Surveys*, Section 5.

6.0 DATA PROCESSING

See Method 9.3, Section 6.

7.0 DELIVERABLES/REPORTING

A survey report should be prepared identifying the survey area, providing the itinerary and a map of survey coverage, and describing the observed fauna.

8.0 HEALTH & SAFETY CONSIDERATIONS

In conducting aerial surveys over bays and estuaries, be especially diligent in searching for and avoiding power lines, buildings and other aircraft. Review Method 9.3, Section 8, regarding ditching and safety equipment.

9.0 PERSONNEL

See Method 9.3, Section 9.

10.0 REFERENCE DOCUMENTS

Method 9.1	Aerial Survey Logistics
Method 9.2	Aerial Navigation
Method 9.3	Open Water Bird and Marine Mammal Surveys
Method 9.4	Exposed Shoreline Bird and Marine Mammal Surveys

Method 9.6
PERMITS

Revision No.: 0
Revision Date: July 9, 1999
Prepared by: Michael Bonnell, Compass-Rose Marine Research
Glenn Ford, R.G. Ford Consulting Company
Prepared for Petroleum Environmental Research Forum (PERF), Project 94-10

1.0 PURPOSE

This method is for obtaining permits from government agencies to conduct aerial surveys that might affect birds and marine mammals. Properly done surveys should not produce impacts. But the potential exists, and because many bird and marine mammal species have small or restricted populations, disturbance can have serious consequences. Permits should be obtained and renewed each year, and invoked as needed by telephone calls to managers of refuges and marine sanctuaries, the Federal permit office, and State departments of fish and wildlife.

2.0 DEFINITIONS

NMFS—National Marine Fisheries Service

NOAA—National Oceanic and Atmospheric Administration

NPS—National Park Service

USFWS—U. S. Fish and Wildlife Service

3.0 EQUIPMENT

None.

4.0 PROCEDURES

Permit applications should be prepared and submitted by the aerial survey contractor for post-spill aerial surveys.

Permits are granted by Federal or State agencies with the expectation that the applicant will comply with reasonable conditions that minimize the chance of disturbance to birds and marine mammals. Government agencies that provide permits carefully study proposed methodology, and specify changes needed to minimize the risk of disturbance.

The likelihood that a permit will be granted depends in large part on the applicant's prior experience and credentials to do the work. The applicant should demonstrate knowledge of the geographic location of sensitive resources and the timing of critical events such as breeding seasons. The permitting process almost always requires several weeks. These permits should be obtained in advance by the biologists who will be conducting these surveys.

This method is to obtain broad regional permits prior to the need to fly surveys following an oil spill. If or when a spill occurs, all necessary permits should be in hand and all appropriate government agencies consulted. Telephone calls can be made to refuge and sanctuary managers, and the specific details (e.g., aircraft track lines) sent by FAX. A partial directory of government agencies that must be applied to for permits is provided below. This list is provided as a general guide; the aerial survey contractors should maintain up to date lists of the appropriate permitting contacts for their geographic regions.

4.1 Responsibilities and Jurisdictions

Through Special Use Permits, the USFWS ensures that important seabird colonies are not subjected to overflights at a distance where noise from an aircraft causes birds to abandon nests. The USFWS also has responsibility for protecting threatened or endangered populations of sea otters, walrus, and manatees. Special Use Permits must be obtained for refuges in each State that might be surveyed.

The NMFS issues marine mammal permits that prescribe no-fly zones (appropriate or required distances and altitudes) around pinniped haulout sites and over the open water that reduce the chance of disturbance to marine mammals (a violation of the Marine Mammal Protection Act of 1972). The NMFS is responsible for protection of seals, sea lions, cetaceans, and sea turtles.

National Parks Service and NOAA for National Marine Sanctuaries along the coast must be consulted for work in their jurisdiction. Special Use Permits must be obtained for each.

State agencies have permitting authority over State parks, and nearshore waters along portions of the coast where sensitive resources occur (e.g., the California Sea Otter Range). Flight at less than 1,000 ft (305 m) over these areas requires a permit from the Director of the State's Department of Fish and Game. A single permit can be obtained for each affected State.

PARTIAL DIRECTORY OF PERMITTING AGENCIES
Last Update: June 1999

MARINE MAMMAL PERMIT

National Marine Fisheries Service (301) 713-2332
Office of Protected Resources
Silver Spring, MD 20910

SPECIAL USE PERMITS

Superintendent (360) 452-4501
Olympic National Park
600 East Park Avenue
Port Angeles, WA 98362-6798

Superintendent
Channel Islands National Park
1901 Spinnaker Dr.
Ventura, CA 93001
(805) 658-5700

Helen Golde
Policy Analyst/Permit Coordinator
National Oceanic and Atmospheric Administration
Marine Sanctuary Division
Office of Ocean and Coastal Resource Management
1305 East-West Highway
Silver Spring, MD 20910
(301) 713-3145 ext. 152

National Wildlife Refuges: Alaska Coast
Philip Johnson
U.S. Fish and Wildlife Service
1011 E. Tudor Road
Anchorage, AK 99503
(907) 786-3483

National Wildlife Refuges: Washington Coast
Refuge Manager
Nisqually National Wildlife Refuge
U. S. Fish and Wildlife Service
100 Brown Farm Road
Olympia, WA 98516
(360) 753-9467

National Wildlife Refuges: Oregon Coast
Refuge Manager
Finley National Wildlife Refuge
U. S. Fish and Wildlife Service
26208 Finley Refuge Road
Corvallis, OR 97333
(541) 757-7236

National Wildlife Refuges: California Coast
Jim Haas
Contaminants Branch
U.S. Fish and Wildlife Service
3310 El Camino, Suite #130
Sacramento, CA 95821
(916) 979-2110

National Wildlife Refuges: Texas Coast
Brian Cain
Environmental Contaminants Office
U. S. Fish and Wildlife Service
17629 El Camino Real, Suite 211
Houston, TX 77058
(281) 286-8282

National Wildlife Refuges: Louisiana Coast
David Fruge (318) 291-3115
Ecological Services Office
U.S. Fish and Wildlife Service
646 Cajundome Blvd., Suite 400
Lafayette, LA 70506

STATE PERMITS

Bruce Schmidt (541) 757-4263 ext. 250
Corvallis Research Lab
Science and Technology Program
Oregon Department of Fish and Wildlife
28655 Highway 34
Corvallis, OR 97333

Director (907) 452-1531
Habitat Division
Alaska Department of Fish and Game
1300 College Rd.
Fairbanks, AK 99701

Director (512) 389-4800
Texas Department of Parks and Wildlife
4200 Smith School Road
Austin, TX 98744

Jim Hanifen, Program Manager (504) 765-2370
Louisiana Department of Wildlife and Fisheries
P. O. Box 98000
Baton Rouge, LA 70898-9000

It is advisable to periodically verify and update this list.

5.0 QUALITY ASSURANCE/QUALITY CONTROL

None.

6.0 DATA PROCESSING

None.

7.0 DELIVERABLES/REPORTING

Permit applications submitted by the aerial survey contractor; any revisions, and permits once received should be copied to the client contracting the work.

8.0 HEALTH & SAFETY CONSIDERATIONS

None.

9.0 PERSONNEL

None.

10.0 REFERENCE DOCUMENTS

None.

Method 9.7
BEACHED ANIMAL SURVEY COORDINATION

Revision No.: 0
Revision Date: July 9, 1999
Prepared by: Glenn Ford, R.G. Ford Consulting Company
Prepared for Petroleum Environmental Research Forum (PERF), Project 94-10

1.0 PURPOSE

Historically, the collection of oiled carcasses has received relatively low priority while a spill is actually in progress. Resources tend to be focussed on the rehabilitation of injured animals rather than on the accurate enumeration of dead ones. The lack of attention to the recording of information on beached animals is not advisable, because these data consistently provide a major component of resource damage assessments. Standardization and quality control in the collection of these data will simplify the post-spill damage assessment process, and help to quantify appropriately the extent of the natural resource damage. This method is for guiding the coordination of beached animal surveys so that data required for estimates of injury to wildlife are collected in the most accurate possible manner.

2.0 DEFINITIONS

None.

3.0 EQUIPMENT

None.

4.0 PROCEDURES

From a practical standpoint, the responsible party's ability to influence the way in which beached animal data are collected is limited. Responsibility for this activity lies within sometimes overlapping state and Federal jurisdictions. In general, the responsible party should attempt to form a liaison with both Federal and state personnel involved in the recovery of beached animals. Emphasis should be on providing logistic and/or financial assistance and on advising the agencies as to the most effective methodology for data collection.

In all waters more than three miles from land, and in most coastal waters to the shoreline, oil spill response is directed by Federal agencies. During an oil spill, the Unified Command, usually composed of representatives from the U.S. Coast Guard, the State, and the Responsible Party, and advised by other Federal and State Agencies, is led by the On-Scene Coordinator (OSC). The OSC coordinates all post-spill response, especially communication, transportation, monitoring the movement of oil, source control, and authorizing use of dispersants and beach clean-up. The OSC in most waters is the U. S. Coast Guard Captain of the Port. (In California, the Unified Command includes the Department of Fish and Game's Office of Oil Spill Prevention and Response, the Federal OSC, and the responsible party, if known). They are not specifically excluded from offering advice, especially in regard to technical matters, and may be solicited for help in aspects of spill response. Methods 9.7 - 9.10 for beach search methodology and collection of data on beached animals should be made

available to the Unified Command through the NOAA Scientific Support Coordinator (SSC) who is responsible for ensuring that sensitive resources are identified.

The following contacts were current as of June 1999. For areas not listed, establishing appropriate contact lists is a valuable part of pre-spill planning. It is advisable to periodically verify and update any list of contacts.

Scientific Support Coordinators:

Alaska (USCG District 17)

NOAA SSC OR&R (907) 271-3593
John Whitney
U. S. Court House Federal Bldg.
222 W. 8th Street, No. 56
Anchorage, AK 99513-7543

California, Oregon, and Washington (USCG Districts 13 and 14)

NOAA SSC OR&R (206) 526-6829
Sharon Christopherson
ORCA/3
7600 Sandpoint Way, NE
Seattle, WA 98115

The Trustee for migratory birds and sea otters, the animals likely to be recovered in the largest numbers following an oil spill, is the U. S. Fish and Wildlife Service. The relevant personnel for initial contact vary by state. Some contacts are:

Alaska	Philip Johnson	(907) 786-3483
Washington	Kate Benkert	(360) 753-9440
Oregon	Stephen Zylstra	(503) 231-6179
California	Barry Todd	(916) 978-4613
Texas	Brian Cain	(281) 286-8282
Louisiana	David Fruge	(318) 291-3115

Parallel structures exist in most states. Although in most states the USFWS will have primary responsibility, it is advisable to coordinate with the appropriate state representative:

Alaska	Tom Rothe	(907) 267-2206
Oregon	Bruce Schmidt	(541) 757-4263
California	Paul Kelly	(916) 323-4335
Texas	Cindy Lefler	(512) 475-1513
Louisiana	Jim Hanifen	(225) 765-2390

The trustee for pinnipeds and cetaceans is the National Marine Fisheries Service. Strandings of pinnipeds and cetaceans are relatively rare in the context of an oil spill. These cases should not be dealt with directly by beached animal retrieval personnel. For coordination of activities related to this kind of stranding, contact the National Marine Mammal Laboratory Stranding Coordinator. Some coordinators are:

NMFS, Seattle, WA	Brent Norberg	(206) 526-6733
NMFS, Long Beach, CA	Joe Cordero	(562) 980-4017

5.0 QUALITY ASSURANCE/QUALITY CONTROL

None.

6.0 DATA PROCESSING

None.

7.0 DELIVERABLES/REPORTING

None.

8.0 HEALTH & SAFETY CONSIDERATIONS

None.

9.0 PERSONNEL

None.

10.0 REFERENCE DOCUMENTS

10.1 Literature

Regional Oil and Hazardous Substance Pollution Contingency Plans, U. S. Coast Guard.

Hazardous Material Incident Contingency Plans, various States.

10.2 Methods

Method 9.7	Beached Animal Survey Coordination
Method 9.8	Allocation of Search Effort for Beached Birds and Mammals
Method 9.9	Beached Animal Retrieval
Method 9.10	Beached Carcass Analysis

Method 9.8
ALLOCATION OF SEARCH EFFORT FOR BEACHED BIRDS AND MAMMALS

Revision No.: 0
Revision Date: July 9, 1999
Prepared by: Glenn Ford, R.G. Ford Consulting Company
Prepared for Petroleum Environmental Research Forum (PERF), Project 94-10

1.0 PURPOSE

This method is for planning the allocation of search effort for beached birds and mammals along an oil affected coastline.

2.0 DEFINITIONS

None.

3.0 EQUIPMENT

1. USGS 1:24,000 maps or best available scale for the impacted area. USGS maps are easier to relate to the coastline, and are preferred to NOAA nautical charts for this purpose.
2. Shoreline classification maps if available.
3. Local tide tables.

4.0 PROCEDURES

4.1 Location of Searches

4.1.1 Background

This method deals with planning and allocating search effort related to the recovery of beached animals following an oil spill. The actual logistics and the selection of personnel related to this effort are the jurisdiction of the Unified Command.

The distribution of beached animals typically follows the distribution of beached oil, as does the timing of the arrival of beached animals. The most basic strategy of allocating search effort is to go to those beaches where oil has been reported. Whenever possible, beached animal search effort should occur prior to the arrival of cleanup crews since these crews historically have a tendency to consider oiled animal carcasses in the same category with oiled debris.

An exception to the pattern of the concurrent arrival of oil and beached animals may occur when a large number of oiled but active seabirds come ashore. These animals will actively beach, and may arrive hours in advance of the oil or even arrive on beaches that remain unoiled. Seabirds that have received a level of oiling that will ultimately prove lethal, are capable of moving as much as 10 or 20 km toward land by flying or swimming.

Another set of circumstances in which the arrival of floating oil and beached animals do not coincide may occur when the spilled oil dissipates more rapidly than the animal carcasses sink. Floating seabird carcasses usually persist from one to three weeks, the persistence time decreasing with increasing wind chop and wave height. Bird carcasses are therefore sometimes recovered further down the path of an oil trajectory than is the beached oil itself.

4.1.2 Selection of Beaches to Search

All available information on the extent of the slick, projected trajectory of oil, and oil landfall should be obtained from the On Scene Coordinator or his designated representative. Using this information and maps of the area, beach segments should be defined based on substrate type, accessibility, and jurisdiction (Method 9.7). A beach segment to be searched should be homogeneous relative to all these characteristics and should be no longer than can be walked during one tidal cycle.

The selection of areas to search can be made partially on the basis of where oil is observed coming ashore. On-scene trajectory modeling can also be used to predict roughly when oil and beached animals are likely to begin arriving. Animal carcasses exhibit drift characteristics very similar to floating oil relative to winds and surface currents: that is, the surface current plus 2-4% of the wind speed and direction. Oil spill trajectory models may therefore be used to predict the arrival of beached animals even if the spilled product has dissipated.

If it is logistically possible, the entire area potentially impacted by the oil should be searched for carcasses, searching especially along the strandline of the most recent set of high tides. If not, then searchers should concentrate on shoreline segments where oil or beached animals have been reported. Adjacent areas should also be checked in order to define the extent of the affected area.

If only a subset of the affected area is to be searched, then a representative set of beach types within the area affected by the spill should be selected. The NOAA beach type classification, available for much of the US coastline, can be used for this stratification (NOAA 1995). In some cases a more detailed description of beaches may be available (e.g., Carter and Page 1988, for Central California). It is better to sample a subset of the beaches well and to use these results for extrapolation to the entire area than to sample a larger portion of the affected area poorly. Beaches designated to be searched should be assigned an identifying name for use on data forms. Each should be unique. Beach segments should be defined precisely (see Method 1.6–*Shoreline Segmentation*).

4.2 Timing of Search Effort

4.2.1 Background

Animal carcasses typically begin arriving at the same time the shore becomes oiled. The arrival rate usually peaks rapidly, but may taper off over a period of a week or more. Depending on the substrate, carcasses persist on the beach for varying lengths of time. On most substrates, however, the persistence of beached animals is surprisingly short, often on the order of only 50% per day. Carcasses disappear for a

variety of reasons, but the most common are (1) scavenging, (2) burial , or (3) rewash back out to sea. It is therefore desirable to search beaches as frequently as possible.

4.2.2 Scheduling

Beaches should be searched after each tidal cycle or once a day for the first several days following the beginning of the arrival of animal carcasses. After the arrival rate has dropped to 10% or 20% of the peak arrival rate, beaches should still be searched two to three times a week until the arrival rate of oiled animals declines to pre-spill levels. Note that not all beached animals are oiled, and recoveries of unoiled beached animals may later be of considerable use in separating oil spill related mortality from natural mortality.

5.0 QUALITY ASSURANCE/QUALITY CONTROL

Scientifically trained personnel who are familiar with the area should plan the beach search effort.

6.0 DATA PROCESSING

None.

7.0 DELIVERABLES/REPORTING

The rationale for choosing particular beach segments for searching and the scheduling of searches should be recorded.

8.0 HEALTH & SAFETY CONSIDERATIONS

None. The safety of personnel engaged in beach searches is the responsibility of the Unified Command. Those who conduct the search effort should follow the spill Site Safety Plan. Personnel involved only in planning the search effort have no special health and safety considerations.

9.0 PERSONNEL

Personnel planning the search effort should have some training in statistical sampling procedures.

10.0 REFERENCE DOCUMENTS

10.1 Literature

Carter, H.R., and G.W. Page. 1988. Central California Oil Spill Contingency Plan: Assessment of numbers and species composition of dead beached birds. Prepared for Gulf of the Farallones National Marine Sanctuary.

National Atmospheric and Oceanic Administration (NOAA). 1995. Technical Memorandum NOS ORCA 92, Environmental Sensitivity Index Guidelines.

10.2 Methods

Method 1.6	Shoreline Segmentation
Method 9.7	Beached Animal Survey Coordination
Method 9.8	Allocations of Search Effort for Beached Birds and Mammals
Method 9.9	Beached Animal Retrieval

Method 9.9
BEACHED ANIMAL RETRIEVAL

Revision No.: 0
Revision Date: July 9, 1999
Prepared by: Glenn Ford, R.G. Ford Consulting Company
Prepared for Petroleum Environmental Research Forum (PERF), Project 94-10

1.0 PURPOSE

This method describes searching of beaches for birds and mammals and recording both search effort and animals retrieved.

2.0 DEFINITIONS

ATV—All Terrain Vehicle.

3.0 EQUIPMENT

1. USGS 1:24,000 maps or best available scale for the impacted area. USGS topographic maps are easier to relate to the coastline, and are preferred to NOAA nautical charts for this purpose.
2. Local tide tables.
3. Binoculars.
4. Waterproof field notebooks/recording forms.
5. Forms 9.3 and 9.4 copied on waterproof paper.
6. Pencils.
7. Stapler.
8. Waterproof boots.
9. Heavy gauge plastic bags for individual specimens, 1-gallon capacity with closures.
10. Heavy duty garbage bags for groups of specimens, about 30 gallon capacity.
11. Animal-carrying containers (domestic cat size), cardboard, for removal of live oiled birds to rehabilitation centers.
12. Specimen tags indelibly marked with unique ID numbers.
13. 35-mm SLR camera with ASA 200 or 400 film.
14. Flagging tape for marking locations of bags.
15. Solvent rinsed glass jars with Teflon lined lids for oil samples.
16. Radio communications equipment for use in remote areas.
17. Insulated flotation/work suits for use in extreme weather conditions and landing from boats.
18. 12 gauge shotgun, or equivalent, for use in Alaska.
19. Planes/helicopter/boats: if needed, depending on access (see Appendix B).

4.0 PROCEDURES

4.1 Preparation

Prior to performing the activities of this Method, the previous two Methods should be reviewed (i.e., Method 9.7–*Beached Animal Survey Coordination* and Method 9.8–*Allocation of Search Effort for Beached Birds and Mammals*).

4.2 Transportation

Shorelines vary widely in terms of their accessibility and the best method of transport. Access will be dependent on weather and sea state and often requires local knowledge. For example:

Alaska: Very little of Alaska is accessible by road. Access will be either by boat or helicopter. Landing from boats will be accomplished using small inflatable craft such as Zodiacs. Some stretches of coast are inaccessible using any method. In all cases, workers should be outfitted appropriately, typically in flotation/work suits. Much of the Alaskan coast is utilized by bears which can be a source of danger to work crews, particularly since bears may be present in unusually high numbers to feed on the beached animals. In such areas, one member of the crew should be trained as a bear guard and armed.

Washington: From Cape Flattery south to the Quinault River, access is difficult and searchers will have to arrive by helicopter or hike overland to reach the beach. In some rocky areas along the Olympic Peninsula, access is possible only by rappelling down from the cliffs above. South to the Columbia River along the outer coast, access by road is relatively easy as is getting from the road to the beach. Similarly, along the southern side of the Straits of Juan de Fuca and throughout Puget Sound in general access by road is practical.

Oregon: Access to the coast by road is good along the entire outer coast, but in many places getting from the road to the beach may prove difficult or impossible. Access is likely to be especially difficult from Cape Blanco south, where cliffs often preclude access from the landward side. Many of these areas can be reached by inflatable boats or by helicopter at low tide.

California: Access to the coast by road or boat is good along the California coast from the Mexican border to Pt. Piedras Blancas, difficult in some areas from Pt. Piedras Blancas to Pt. Sur (some areas may be completely inaccessible), and good from Pt. Sur to Bodega Head. North of Bodega Head to Cape Mendocino, some areas are difficult to access from the land. North of Cape Mendocino to the Oregon border, most areas are accessible by road. Most offshore islands are accessible by boat.

Other Areas: Information on coastal access should be obtained from local sources.

4.3 Beach Searches

Most beached animals are deposited along the highest tide line ("wrack line"). Some animals, however, may move or be carried by scavengers higher on the beach where they could be overlooked by the search team. Since carcasses may be partially covered with sand, wood, kelp, or mousse (an oil-water emulsion), searchers must work carefully, often

zigzagging across the beach as they go. Seven or eight power binoculars can save time by allowing searchers to view from a distance objects that might be beached animals. Sandy beaches can be effectively searched using ATVs or four wheel drive vehicles as well as on foot. Note that driving safely on sandy beaches requires experience and should not be undertaken by untrained personnel.

It is easy to miss carcasses the size of seabirds even in good weather on a flat sandy beach. Oiled cobble beaches and wavecut platforms are especially difficult to search. In the case of cobble beaches, oiled seabirds are about the same size and color as the beach itself; in the case of wavecut platforms, walking can be difficult and carcasses may be lodged under rocks, in crevices, or in tide pools.

As with any scientific survey procedure, an accurate record of search effort is critical to the quality of data. A common error is for searchers to go where they think the largest numbers of beached animals are likely to be found. Later, working with poorly recorded estimates of effort, analysts may extrapolate this biased sample to other beaches with fewer animals, resulting in overestimates of the numbers of beached animals. To avoid this type of problem, search teams should record the following information each time a segment of beach is searched (see Form 9.4–*Beach Search Effort*).

1. Date and time at the beginning and end of the search.

2. The location of the area being searched. Location relative to within about 1 km of local land marks should be noted. If possible, locations should be depicted on USGS or equivalent maps.

3. The names of the personnel engaged in the search.

4. The tidal level at the beginning of the search.

5. Estimated linear distance covered by all searchers.

6. The estimated width of the search corridor if it is less than the width of the beach face.

7. Weather and light conditions.

8. Photographs showing the beach structure and the typical disposition of carcasses (if any) along the beach.

This information MUST be recorded EVEN IF no carcasses are found. A completed example form is shown in Figure 9.9-1.

4.4 Beached Dead Bird Retrieval and Recording

As the searchers proceed, they should gather up both live and dead birds. Dead birds should be tagged and placed individually in small plastic bags before being placed in larger bags. DO NOT place more than one animal in a bag as this may alter the pattern of oiling or cause unoiled carcasses to appear oiled. A unique ID tag should be affixed to each carcass before it is placed in the bag. Bags of birds can be left on the beach for later removal, but should be placed above the high tide line so they will not be washed away.

Who filled out this form? (name & affiliation): Jane Walnut, WAS

SEARCH INFORMATION

Date: 9/23/93 **Beach Name or ID:** Apple Beach

Start Time: 10^00 am **End Time:** 3^15 pm

Searchers (last name, initial):

1. Walnut J
2. " A
3. Spoonr B
4.
5.
6.
7.
8.
9.

ASSOCIATED DATA

Map Reference: Apple Beach Fruitcore Quad **Film (identify roll numbers):** Roll 33

Live Birds/Mammals (include numbers, species, disposition): 2 birds (1 died)

Dead Birds/Mammals (numbers): 8 birds, 1 (?) seal
(IMPORTANT: if none, put NONE)

List Tag Numbers Used: AA 0001 → AA 0008

INFORMATION ON BEACH SEARCHED:

Length of Beach Walked: From Green Pt. Light to Apple Beach SP parking lot

Length: 2 (km) / miles **Width:** 30-50 (meters) / yards

General Condition of Birds: No Oil | Slightly Oiled | (Heavily Oiled) | Moussed

Beach Condition: No Oil | (Slightly Oiled) | Heavily Oiled | Moussed

Substrate: Mud | (Sand) | Marsh | Pebbles (diameter:___)
Cobbles (diameter:___) | Rock Platform | Other:___

Dominant Color of Substrate: light tan

GENERAL

State of Tide: going out **Weather:** cloudy **Visibility:** good

Figure 9.9-1. Sample beach search effort form (Form 9.4).

On beaches where bear scavenging is likely, bags should be removed as soon as possible since bears will tear up or remove bagged animals. It is important that carcasses be marked to prevent their being counted more than once. If carcasses cannot be removed, they should be tagged to prevent recounting. The beach census form should note that the carcass was left where found.

Procedures for the examination and analysis of carcasses are provided in Method 9.10–*Beached Carcass Analysis*. Along wild stretches of beach, especially in Alaska and northern Washington, both avian and mammalian scavengers may rapidly descend on the carcasses of beached animals. If very much time elapses between the arrival of the beached animals and the arrival of the searchers, many of the remaining carcasses may be partially or almost totally consumed. In this case, searchers will not be dealing with intact carcasses, but rather with piles of bones and skin or feathers. These remains should be collected and bagged as with intact carcasses. To the extent possible, each bag should contain the remains of a single animal, but this will not always be possible. Where a single wing, or two wings joined together, are all that remains of a carcass, an attempt should be made to estimate the number of carcasses in this condition. Searchers should not spend a great deal of time trying to decide where one carcass ends and another begins, but rather should let this be determined as best as possible at the collection center.

Information on each bird carcass should be recorded as it is picked up and tagged. Minimal data on the condition of the carcasses should be recorded in the field, since they should be examined in detail at the collection centers. Information to be noted includes the following (see Form 9.5–*Beach Census*):

1. Unique ID - The tag number. The ID consists of a two-letter code (e.g., AA), supplied by the Beach Search Coordinator and referenced to the date, location, and particular collection team, followed by a 4-digit number (e.g., 0001) to be written on the tag by the collection team leader (Figure 9.9-2).

2. Taxon (species if possible) if known. Detail here is not necessary since carcasses will be examined at the collection center.

3. Details about location and condition on the beach. Beach locations to within about 1 km of a nearby landmark and the position relative to that landmark should be noted (see also Form 9.4).

A completed example Form 9.5 is shown in Figure 9.9-2.

4.5 Live Birds

Live birds should be placed in cardboard carrying containers for transfer to rehabilitation centers. Details of the transfer may vary and should be determined in consultation with government agencies and bird rescue groups. Live birds should be recorded on the beach census form, with "live" noted in the comments field. Live birds that die before transfer to rehabilitation centers should be tagged and bagged as dead birds; their history should be noted on the bird census form.

Who filled out this form? (name & affiliation): Jane Walnut, NAS **Page:** 1

SEARCH INFORMATION

Date: 9/22/93 **Beach Name or ID:** Apple Beach

Start Time: 10^00 a.m. **End Time:** 3^15 p.m.

Searchers (last name, initial):

1. Walnut J
2. " A
3. Spooner B
4.
5.
6.
7.
8.
9.

ANIMALS FOUND: List one per line, use additional forms if necessary.

		Position on Beach						
Tag Number	Species/ Taxon	Below Wrack	On Wrack	Above Wrack	Back Beach	Oiled? (Y/N)	Scav? (Y/N)	Comments/ Disposition
AA0001	Murre		x			Y	N	
	Murre	x				Y	N	Live
AA0002	Gull			x		N	Y	partly buried
AA0003	?		x			Y	N	stuck together w/ oil
AA0004	?		x			Y	N	
AA0005	?		x			Y	N	
	Seal?	x						Dead- rotten
AA0008	Murre	x				Y	N	Live. Died
AA0006	Gull				x	?	Y	under bog
AA0007	Duck		x			Y	N	

NOTES One murre found alive died on way to car. Tagged.

Figure 9.9-2. Sample beach census form (Form 9.5).

4.6 Marine Mammals

Marine mammal strandings are relatively rare in most spills, and strandings may not even be directly related to the effects of the oil spill. Whether live or dead, marine mammals should not be retrieved from the beach. They should, however, be noted on the beach census form. The coordinator should forward reports of beached mammals to the appropriate agencies (see Method 9.7–*Beached Animal Survey Coordination*).

5.0 QUALITY ASSURANCE/QUALITY CONTROL

Tag control: Tags should be issued to search groups by a coordinator, who should also collect any unused tags when the forms and beached animals are returned. If more than one coordination center is used, identifiably different sets of tags should be issued by each.

Data forms control: The search coordinator(s) should collect the beach search effort form, location map, and beach census forms with any unused tags from each team at the end of the search. The coordinator(s) should quickly check the forms for completeness and obtain any missing information — date, time, location, and personnel are imperative on the beach search form and the beach census form so that the two sets of data may be linked. The Tag ID is required on the beach census form so that the location may be linked to the tagged carcass. Each set of forms, including the map, from each search team should be stapled together by the coordinator after they are checked. Forms should be retained by the coordinator until they can be copied and transferred to a central data repository.

Film control: Exposed film should be given to the coordinator along with the data forms. The coordinator should check to see that (1) the roll and frame numbers are recorded on the beach search effort form and (2) the film itself is labeled with the date, time, roll number, beach segment, and photographer's name.

Carcass control: The carcass bags should be checked by the coordinator to ensure that carcasses are properly tagged and bagged. Untagged carcasses should be tagged with a unique sequence by the coordinator, who should fill out a beach census form indicating that the carcass was not tagged upon collection. All carcasses should then be delivered to the collection center for further analysis. Bags left on the beach should be collected as soon as possible. Prompt delivery of carcasses to collection centers is important as information will be lost as the carcasses decompose. Taxonomic and oiling status become more difficult to assess as decomposition proceeds.

6.0 DATA PROCESSING

Packets of forms and rolls of film from each beach-search team should be logged by the central data repository as they are received from the coordinator(s). Data from the beach effort and census forms may be entered into a computer database, if desired, for future analysis (see Method 14.4–*Photographic and Video Data* and Method 14.8–*Oiled Wildlife Data*).

Data on a subsample of the search effort and of the animals retrieved may be combined with other records to extrapolate total estimated mortality. For example, results from a 1-km section of southeast facing pebble beach might be extrapolated to an adjacent additional 2 km of southeast facing pebble beach. Methods will vary depending on the availability of data. This portion of the study cannot be preplanned in detail.

7.0 DELIVERABLES/REPORTING

Beach Search Team:

1. Beach search effort forms, map, and beach census forms for each search area, to be given to the coordinator. Film used should also be given to the coordinator, labelled with date, time, roll number, beach segment, and photographer's name. Film should be processed as soon as possible. Any unused tags should also be returned.

2. Bagged carcasses to be delivered to the coordinator for transfer to collection center.

3. Live birds and reports of marine mammals to be delivered to the coordinator.

Coordinator:

1. Collected carcasses to be delivered to collection center. Beach search effort forms, maps, and beach census forms (each set stapled together) to be stored until they can be copied and transferred to a central data repository.

2. Live birds and marine mammal reports to be delivered to the appropriate authorities.

8.0 HEALTH & SAFETY CONSIDERATIONS

Personnel should dress appropriately for the weather, work in teams, and be aware of tidal cycles to avoid being stranded. Many beach segments are inherently dangerous, especially when high tides and high seas may be encountered on narrow beaches. Special care must be taken when working/walking among oiled rocks. Drivers of ATVs or four wheel drive vehicles should have received appropriate training for the operation of these vehicles on beaches. Protective gear should be worn in extreme conditions in Alaska, or when working from boats or aircraft. Bear guards should be used where bears may be present (primarily Alaska). Personnel should always use discretion, especially during bad weather.

It is required that individuals working on oiled beaches receive OSHA Hazardous Waste Operations and Emergency Response (HAZWOPER) training. OSHA/RCRA hazardous waste safety training is available through the National Spill Control School, (512) 991-8692.

9.0 PERSONNEL

One coordinator for each search center shall have control of animal tags, beach search effort and census forms, and local maps. This person will also assign teams to beach segments, allowing for beach search difficulty and the physical condition of searchers. The coordinator will also need a working knowledge of the other methods of this rationale in order to evaluate data needs and to coordinate with other groups.

Search teams of 2-5 people should be responsible for particular stretches of beach. Beached animal census work can be physically tiring or exhausting, depending on the health and stamina of the searcher. A brief training session covering procedures and data recording requirements should be conducted for the search teams. One person per search team should be responsible for returning forms to the coordinator.

10.0 REFERENCE DOCUMENTS

Method 9.7	Beached Animal Survey Coordination
Method 9.8	Allocation of Search Effort for Beached Birds and Mammals
Method 9.10	Beached Carcass Analysis
Method 14.4	Photographic and Video Data
Method 14.8	Oiled Wildlife Data

Method 9.10
BEACHED CARCASS ANALYSIS

Revision No.: 0
Revision Date: July 9, 1999
Prepared by: Glenn Ford, R.G. Ford Consulting Company
Prepared for Petroleum Environmental Research Forum (PERF), Project 94-10

1.0 PURPOSE

This method describes data recording procedures at the carcass collection center.

2.0 DEFINITIONS

None.

3.0 EQUIPMENT

1. Disposable gloves.
2. Coveralls and/or rubber aprons.
3. Plastic sheeting.
4. Work tables (at least 2 ft x 6 ft).
5. Duct tape.
6. Plastic bags.
7. Paper towels.
8. Pre-numbered ID tags for carcasses and tag log.
9. Morgue record forms (Form 9.6).
10. Pencils.
11. Face masks with air filters.

4.0 PROCEDURES

4.1 Background

Carcasses will be delivered to a collection center (multiple centers in case of a large spill over a wide area). After processing, carcasses should be frozen for storage. Processing should take place as soon as possible to prevent further deterioration of their condition. For final storage, care should be taken that the individual bags are tightly sealed to prevent the leakage of fluids and formation of large blocks of inseparably frozen carcasses. Storage facilities should have trustworthy freezers and power supplies to prevent later accidental thawing and decomposition. Freezers should be checked regularly to ensure that they are functioning properly.

4.2 Examination of Specimens

Examination and species identification should occur at the collection center under the direction of qualified individuals (see Section 9.0). Carcasses should be removed from their bags and placed on tables for examination. When the examination is completed, they should be placed in fresh individual plastic bags, sealed, and frozen.

4.3 Data Recording

Results of examination should be recorded on Form 9.6–*Morgue Record.* For each specimen, data recorded should include:

1. The unique specimen identification number. This is the tag number and is crucial to linking data regarding the carcass itself to data regarding its origin. If the carcass has no tag, a tag should be affixed, from a unique sequence, and this tag number should be used on the morgue record. This tag number should also be entered into a log, which should record as much as is known about the origin of the carcass — for example, if it was in a bag with tagged specimens, their tag numbers or if it died at a rehabilitation center, name of rehabilitation center and date.

2. The species or closest possible taxonomic ranking. Ainley et al. (1980) have published an excellent guide to identification of beach-cast birds and mammals on the Pacific coast. This manual contains keys, identifying marks, and line drawings. Carcasses that are heavily oiled or in fragments may be difficult to identify. If identification to species is not possible, the most specific taxonomic classification possible should be used. If species are identified by codes, a master list of codes used should be maintained to facilitate later analysis. Four-letter species codes are commonly used; however, there is less than complete consistency in coding, especially for specimens that are identified only to genus or family.

3. Age class and sex of specimen if identifiable. For many marine animals, this may be very difficult or impossible to determine.

4. Intactness of carcass—Whether intact or, if parts only, which parts are present. In some cases, it is difficult to decide where one carcass ends and another begins. Parts that are assembled to form one "carcass" should not include more than one left or right wing, skull, or left or right legs.

5. Degree of decomposition—Fresh; fur or feathers sloughing; skin, fur, feathers, and bones only; or bones only. See (6) below for more detail on distinguishing decomposition from scavenging.

6. Evidence of scavenging—Incomplete carcasses indicate either scavenging or decomposition, and the difficulty lies in deciding which has occurred. Initial stages of scavenging include opening of the body cavity and damage around the eye orbits and nares. Some scavengers begin by peeling the skin back up over the head, partially or fully obscuring the head and beak. More advanced stages of scavenging and decomposition may involve mostly skeletal remains. If significant amounts of flesh, rotting or otherwise, still adhere to the skeleton, but the skeleton is partially or entirely dismembered, the most likely interpretation is scavenging. If most of what remains are bone and fur or feathers, examiners should look at the condition of particles of flesh that remain. If the flesh is dark reddish brown, almost black, and hard, and ligaments and tendons still connect the parts of the skeletal structure, the likely interpretation is decomposition. If major skeletal elements such as wings or legs or head are separated and the remaining flesh is relatively fresh, the interpretation would be scavenging.

7. Degree of oiling—Whether oiled and, if oiled, approximate percent coverage and pattern of oiling. If encased in mousse or tar, this should be noted here also.

8. The pattern of oiling—Whether on the entire carcass or, if not, which parts of the carcass are oiled. Location of oil on the carcasses can assist in determining whether carcasses were oiled before or after death.

9. Presence of banding rings or other scientific identification.

10. The name of the examiner, date of the examination, and disposition of the carcass (e.g., returned to freezer, sent to lab for necropsy, etc.).

Figures 9.10-1 and 9.10-2 show two completed examples of Form 9.6.

5.0 QUALITY ASSURANCE/QUALITY CONTROL

The most important measure is use of experienced personnel and rigorous checking of forms for completeness and consistency. This is much more easily done at the time when the data are being collected rather than at a later date.

6.0 DATA PROCESSING

Data may be entered into a database for further analysis (see Method 14.8–*Oiled Wildlife Data*). If this step is taken, care should be taken that common field names and descriptions match those used for entering beach search effort and beach census data (see Method 9.9–*Beach Animal Retrieval* and Appendix A–*Species Checklist*).

7.0 DELIVERABLES/REPORTING

One morgue record form per carcass, plus log of new tags issued.

8.0 HEALTH & SAFETY CONSIDERATIONS

Morgue personnel should wear coveralls or waterproof aprons and rubber gloves during these procedures. If the carcasses are in an advanced state of decomposition, face masks with air filters adequate to at least partially block the odor are advisable.

9.0 PERSONNEL

Species identification is best accomplished by trained biologists with marine bird experience. If there are a large number of specimens (for example, well over 30,000 bird carcasses were logged into morgues following the *Exxon Valdez* spill), less highly trained technicians may work under the supervision of an experienced marine bird biologist. The supervisor(s) should give any needed training to workers under their supervision, to ensure consistency in recording. If uncertainty exists about the identification or characteristics of a carcass, the supervisor should always be consulted.

Tag ID Number: AA 0004 **Examiner:** Sea Biologist

Species: COMU **Date:** 2/25/93

Age Class: adult **Page:** 8

Sex: ? **Disposition:** to freezer

Degree of Decomposition	Intactness of Carcass	Evidence of Scavenging	Degree of Oiling	Pattern of Oiling
[ ] Fresh	[✓] Intact	[✓] None	[ ] None	[✓] Entire Body
[✓] Fur or feathers Sloughing	[ ] Parts Only (specify below)	[ ] Body Cavity Opened	[ ] Unknown	[ ] Dorsal Only
[ ] Skin, Fur, Feathers, Bones	[ ] Head	[ ] Fresh Tissue on Bones	[ ] < 2%	[ ] Wings Only
NOTES:	[ ] Wings	NOTES:	[ ] 2-33%	[ ] Dorsal and Ventral
	[ ] Legs		[ ] 33-66%	[ ] Head
	[ ] Feet		[ ] > 66%	[ ] Feet
	[ ] Sternum		[✓] Encased	[ ] Other
	[ ] Other		NOTES: with AA0003, AA0005	NOTES:
	NOTES:			

GENERAL NOTES: untagged CAAU stuck to leg w/oil. Given tag # M00016

Figure 9.10-1. Sample morgue record form (Form 9.6).

Tag ID Number: M0006 **Examiner:** Sma Biologist

Species: CAAU **Date:** 2/25/93

Age Class: adult **Page:** 9

Sex: ? **Disposition:** to freezer

Degree of Decomposition	Intactness of Carcass	Evidence of Scavenging	Degree of Oiling	Pattern of Oiling
Fresh	Intact	None	None	✓ Entire Body
Fur or feathers Sloughing	Parts Only (specify below)	Body Cavity Opened	Unknown	Dorsal Only
Skin, Fur, Feathers, Bones	Head	Fresh Tissue on Bones	< 2%	Wings Only
NOTES:	Wings	NOTES:	2-33%	Dorsal and Ventral
	Legs		33-66%	Head
	Feet		> 66%	Feet
	Sternum		✓ Encased	Other
	Other		NOTES: Stuck to AA 0004	NOTES:
	NOTES:			

GENERAL NOTES: _____

Figure 9.10-2. Sample morgue record form (Form 9.6).

10.0 REFERENCE DOCUMENTS

10.1 Literature

Ainley, D.G., G.W. Page, L.T. Jones, L.E. Stenzel, and R.L. LeValley. 1980. Beached marine bird and mammals of the North American West Coast: A manual for their census and identification. U.S. Fish and Wildlife Service, Biological Services Program, FWS/OBS-80-80/03. 207 p.

10.2 Methods

Method 9.9	Beached Animal Retrieval
Method 14.8	Oiled Wildlife Data
Appendix A	Species Checklist

APPENDIX A

SPECIES CHECKLIST

APPENDIX A
SPECIES CHECKLIST

C = Common; U = Uncommon; R = Rare

Field Code	Common Name	Scientific Name	AK and B.C.	CA, OR, WA	Gulf of Mexico	Atlantic Coast
Offshore and Coastal Waters: Marine Mammals - Cetaceans						
MMUW	Unidentified whale	[Unidentified whale]				
MMUX	Unidentified small whale	[Unidentified small whale]				
MMUY	Unidentified medium whale	[Unidentified medium whale]				
MMUZ	Unidentified large whale	[Unidentified large whale]				
MMUD	Unidentified dolphin	[Unidentified dolphin]				
MMBM	Bowhead whale	*Balaena mysticetus*	C			
MMER	Gray whale	*Eschrichtius gibbosus*	C	C		
MMBL	Blue whale	*Balaenoptera musculus*	R	C	R	U
MMBP	Finback whale	*Balaenoptera physalus*	C	C	R	C
MMBB	Sei whale	*Balaenoptera borealis*	C	U	U	C
MMBA	Minke whale	*Balaenoptera actorostrata*	U	C	R	C
MMMN	Humpback whale	*Megaptera novaengliae*	C	C	R	U
MMBG	Right whale	*Balaena glacialis*	R	R	R	C
MMPM	Sperm whale	*Physeter catodon*	U	C	R	C
MMKU	Unidentified pygmy sperm whale	*Kogia sp.*	U	U	U	U
MMKB	Pygmy sperm whale	*Kogia breviceps*		U	U	U
MMKS	Dwarf sperm whale	*Kogia simus*		U	U	U
MMMU	Mesoplodon beaked whale	*Mesoplodon sp.*	C	U	U	
MMZX	Cuvier's beaked whale	*Ziphius cavirostris*	U	U	U	U
MMFA	Pygmy killer whale	*Feresa attenuata*			U	
MMDL	Beluga whale (White whale)	*Delphinapterus leucas*	C			
MMMM	Narwhal	*Monodon monoceros*	U			
MMBW	Baird's beaked whale	*Berardius bairdi*	R	R		
MMHA	Bottlenose whale	*Hyperoodon ampullatus*	R	R		
MMPC	False killer whale	*Pseudorca crassidens*	R	U	U	U
MMOO	Killer whale	*Orcinus orca*	C	C	U	C
MMGM	Pilot whale	*Globicephala melaena*	R	C	U	C
MMLO	Pacific white-sided dolphin	*Lagenorhynchus obliqidens*	U	C		
MMLA	Atlantic white-sided dolphin	*Lagenorhynchus acutus*				C
MMDD	Common dolphin	*Delphinus delphis*	R	C	U	C
MMLB	Northern right-whale dolphin	*Lissodelphis borealis*	R	C		
MMGG	Risso's dolphin	*Grampus griseus*	C	C	U	C
MMPD	Dall's porpoise	*Phocoenoides dalli*	C	C		
MMPP	Harbor porpoise	*Phocoena phocoena*		C		U
MMTT	Bottlenose dolphin [Pacific]	*Terciops gilli*		C	C	C
MMSU	Unidentified Stenella dolphin	*Stenella sp.*		U		U
MMSA	Spotted dolphin	*Stenella dubia*		U	U	U
MMSL	Spinner dolphin	*Stenella longirostris*		U	U	
MMSC	Striped dolphin	*Stenella caeruleoalba*		U	U	U
MMSP	Rough-toothed dolphin	*Steno bredanensis*		U	U	U
Offshore and Coastal Waters: Marine Mammals - Pinnipeds						
MMUP	Unidentified pinniped	*Pinnipedia sp.*				
MMUL	Unidentified sea lion	[Unidentified sea lion]				
MMUS	Unidentified phocid	*Phocidae sp.*				
MMUO	Unidentified otariid	*Otariidae sp.*				
MMZC	California sea lion	*Zalophus Californianus*		C		
MMEJ	Steller sea lion	*Eumetopias jubatus*	C	C		
MMCU	Northern fur seal	*Callorhinus ursinus*	C	C		
MMAT	Guadalupe fur seal	*Arctocephalus philippi*		U		
MMMA	Northern elephant seal	*Mirounga angustirosis*	U	C		
MMPV	Harbor seal	*Phoca vitulina*	C	C		U
MMPL	Largha seal	*Phoca largha*				
MMPH	Ringed seal	*Pusa hispida*	C			U

Field Code	Common Name	Scientific Name	AK and B.C.	CA, OR, WA	Gulf of Mexico	Atlantic Coast
Offshore and Coastal Waters: Marine Mammals - Pinnipeds (Continued)						
MMHF	Ribbon seal	*Histriophoca fasciata*	C			
MMEB	Bearded seal	*Erignathus barbatus*	C			U
MMOR	Walrus	*Odobenus rosmarus*	U			U
Sirenia (inshore and brackish waters)						
MMTM	West Indian Manatee	*Trichetus manatus*			U	R
Ursidae (ice fields)						
MMUM	Polar Bear	*Thalarctos maritimus*	U			
Mustelidae (coastal nearshore waters)						
MMEL	Sea otter	*Enhydra lutris*	C	C		
MMLC	River otter	*Lutre canadensis*	C	U	C	R
MMMV	Mink	*Mustela vison*	C	C	C	C
Turtles, Tortoises, and Terrapins						
TULO	Loggerhead turtle	*Caretta caretta*		R	U	U
TUGR	Green turtle	*Chelonia mydas*		R	R	R
TUPR	Pacific ridley turtle	*Lepidochelys olivacea*		R		
TUKR	Kemp's ridley turtle	*Lepidochelys kempii*			U	
TULE	Leatherback turtle	*Dermochelys coriacea*		U	R	R
TUHA	Hawksbill turtle	*Eretmochelys imbriata*			R	R
TURB	Plymouth red-bellied turtle	*Chrysemys rubriventris bangsi*				R
TUBO	Bog turtle	*Clemmys muhlenburgi*				U
TUUN	Unidentified sea turtle	[Unidentified sea turtle]				
TOGO	Gopher tortoise	*Gopherus polyphemus*				C
TEDI	Diamondback terrapin	*Malalclemys terrapin*				C
Seabirds						
ARLO	Loon, Arctic	*Gavia arctica*	U			C
PALO	Loon, Pacific	*Gavia pacifica*	C	C		
COLO	Loon, Common	*Gavia immer*	C	C	C	
RELO	Loon, Red-throated	*Gavia stellata*	C	C		
YELO	Loon, Yellow-billed	*Gavia adamsii*	U	R		
UNLO	Loon, unidentified	*Gavia sp.*				
RNGR	Grebe, Red-necked	*Podiceps grisegena*	C	C		
WEGR	Grebe, Western	*Aechmophorus occidentalis*		C		
CLGR	Grebe, Clark's	*Aechmophorus clarkii*		C		
EAGR	Grebe, Eared	*Podiceps nigricollis*		C	C	
HOGR	Grebe, Horned	*Podiceps auritus*	C	C	C	
PBGR	Grebe, Pied-billed	*Podilymbus podiceps*		R	C	
USGR	Grebe, unidentified small	[Unidentified small grebe]				
ULGR	Grebe, unidentified large	[Unidentified large grebe]				
UNGR	Grebe, unidentified	[Unidentified grebe]				
BFAL	Albatross, Black-footed	*Diomedea nigripes*	C	C		
LAAL	Albatross, Laysan	*Diomedea immutabilis*	U	U		
SHAL	Albatross, Short-tailed	*Diomedea albatrus*	R	R		
UNAL	Albatross, unidentified	*Diomedea sp.*				
NOFU	Fulmar, Northern	*Fulmarus glacialis*	C	C		C
UNFU	Fulmar, unidentified	*Fulmarus sp.*				
AUSH	Shearwater, Audubon's	*Puffinus lherminieri*			C	C
STSH	Shearwater, Short-tailed	*Puffinus tenuirostris*	C	C		
SOSH	Shearwater, Sooty	*Puffinus griseus*	C	C	U	C
BUSH	Shearwater, Buller's	*Puffinus bulleri*		C		
PFSH	Shearwater, Pink-footed	*Puffinus creatopus*	C	C		
BPSH	Shearwater, Buller's x Pink-foot	[Hybrid shearwater]		R		
FFSH	Shearwater, Flesh-footed	*Puffinus carneipes*	U	U		

Field Code	Common Name	Scientific Name	AK and B.C.	CA, OR, WA	Gulf of Mexico	Atlantic Coast
Seabirds (Continued)						
BVSH	Shearwater, Black-vented	*Puffinus opisthomelas*		U		
GRSH	Shearwater, Greater	*Puffinus gravis*		R	U	C
MXSH	Shearwater, Manx	*Puffinus puffinus puffinus*		R	C	C
TOSH	Shearwater, Townsend's	*Puffinus auricularis*		R		
SKSH	Shearwater, Streaked	*Calonectris leucomelas*		R		
COSH	Shearwater, Cory's	*Calonectris diomedea*			U	C
UDSH	Shearwater, unidentified dark	[Unidentified dark shearwater]				
UNSH	Shearwater, unidentified	[Unidentified shearwater]				
MOPT	Petrel, Mottled	*Pterodroma inexpectata*	U	R		
CAPT	Petrel, Cape	*Daption capense*		R		
COPT	Petrel, Cook's	*Pterodroma cooki*	R	R		
STPT	Petrel, Stejneger's	*Pterodroma longirostris*		R		
SOPT	Petrel, Solander's	*Pterodroma solandri*		R		
BCPT	Petrel, Black-capped	*Pterodoma hasitata*			R	R
OTPT	Pterodroma, other	*Pterodroma sp.*				
UNPT	Pterodroma, unidentified	*Pterodroma sp.*				
LHSP	Storm-Petrel, Leach's	*Oceanodroma leucorhoa*	C	C		C
FTSP	Storm-Petrel, Fork-tailed	*Oceanodroma furcata*	C	C		
ASSP	Storm-Petrel, Ashy	*Oceanodroma homochroa*		C		
BLSP	Storm-Petrel, Black	*Oceanodroma melania*		R		
WESP	Storm-Petrel, Wedge-rumped	*Oceanodroma tethys*		R		
LESP	Storm-Petrel, Least	*Halocyptena microsoma*		C		
UNSP	Storm-Petrel, unidentified	[Unidentified storm-petrel]				
LASP	Storm-Petrel, Leach's/Ashy	[Hybrid]		C		
WISP	Storm-Petrel, Wilson's	*Oceanites oceanicus*		R	C	C
WHTR	Tropicbird, White-tailed	*Phaethon lepturus*		R	R	R
RBTR	Tropicbird, Red-billed	*Phaethon aethereus*		R	R	R
RTTR	Tropicbird, Red-tailed	*Phaethon rubricauda*		R		
UNTR	Tropicbird, unidentified	*Phaethon sp.*				
NOGA	Gannet, Northern	*Sula bassana*			C	C
BFBO	Booby, Blue-footed	*Sula nebouxii*		R		
MABO	Booby, Masked	*Sula dactylatra*		R	C	
BRBO	Booby, Brown	*Sula leucogaster*		R	C	R
RFBO	Boody, Red-footed	*Sula sula*		R	R	
UNBO	Booby, unidentified	*Sula sp.*				
MAFR	Frigatebird, Magnificent	*Fregata magnificens*		R	C	
UNTB	Tubenose, unidentified	*Procellariidae sp.*				
BRPE	Pelican, Brown	*Pelecanus occidentalis*		C	C	C
WHPE	Pelican, White	*Pelecanus erythrorhynchos*		C	C	C
AMAN	Anhinga	*Anhinga anhinga*			C	U
BRCO	Cormorant, Brandt's	*Phalacrocorax penicillatus*		C		
PECO	Cormorant, Pelagic	*Phalacrocorax pelagicus*	C	C		
OLCO	Cormorant, Olivaceous	*Phalacrocorax olivaceus*			C	
DCCO	Cormorant, Double-crested	*Phalacrocorax auritus*	C	C	C	C
RECO	Cormorant, Red-faced	*Phalacrocorax urile*	C		C	
UNCO	Cormorant unidentified	*Phalacrocorax sp.*				
SPSK	Skua, South Polar	*Catharacta maccormicki*		R		
POJA	Jaeger, Pomarine	*Stercorarius pomarinus*	C	C	U	U
PAJA	Jaeger, Parasitic	*Stercorarius parasiticus*	C	U	U	U
LTJA	Jaeger, Long-tailed	*Stercorarius longicaudus*	C	U	R	R
UNJA	Jaeger, unidentified	*Stercorarius sp.*				
GWGU	Gull, Glaucous-winged	*Larus glaucescens*	C	C		
WEGU	Gull, Western	*Larus occidentalis*		C		
WGGU	Gull, Western x Glaucous-winged	[Hybrid]		U		
YFGU	Gull, Yellow-footed	*Larus occidentalis livens*		R		
SBGU	Gull, Slaty-backed	*Larus schistisagus*	R			
GBGU	Gull, Great Black-backed	*Larus marinus*				C
HEGU	Gull, Herring	*Larus argentatus*	C	C	C	C
THGU	Gull, Thayer's	*Larus theyeri*	C	C		

Field Code	Common Name	Scientific Name	AK and B.C.	CA, OR, WA	Gulf of Mexico	Atlantic Coast
Seabirds (Continued)						
BOGU	Gull, Bonaparte's	*Larus philadelphia*	C	C	C	C
SAGU	Gull, Sabine's	*Larus sabini*	C	C		R
LAGU	Gull, Laughing	*Larus atricilla*			C	C
CAGU	Gull, California	*Larus californicus*	R	C		
RBGU	Gull, Ring-billed	*Larus delawarensis*		C	C	C
MEGU	Gull, Mew	*Larus canus*	C	C		
HRGU	Gull, Heermann's	*Larus heermanni*		C		
GLGU	Gull, Glaucous	*Larus hyperboreus*	C	R		R
ICGU	Gull, Iceland	*Larus glaucoides*				R
FRGU	Gull, Franklin's	*Larus pipixcan*		R		
LIGU	Gull, Little	*Larus minutus*				U
BHGU	Gull, Common Black-headed	*Larus ridibundus*				R
BBGU	Gull, Lesser Black-backed	*Larus fuscus*				R
IVGU	Gull, Ivory	*Pagophila eburnea*	R			
ROGU	Gull, Ross'	*Rhodostethia rosea*	U			
ULGU	Gull, unidentified large	[Unidentified large gull]				
UMGU	Gull, unidentified medium	[Unidentified medium gull]				
ULAG	Gull, unidentified Larus	[Unidentified Larus gull]				
USGU	Gull, unidentified small	[Unidentified small gull]				
UNGU	Gull, unidentified	[Unidentified gull]				
BLKI	Kittiwake, Black-legged	*Larus tridactyla*	C	C	R	U
RLKI	Kittiwake, Red-legged	*Larus brevirostris*	C			
UNKI	Kittiwake, unidentified	[Unidentified kittiwake]				
BLNO	Noddy, Black	*Anous minutus*			R	
BRNO	Noddy, Brown	*Anous stolidus*			C	R
SOTE	Tern, Sooty	*Sterna fuscata*			C	R
BRTE	Tern, Bridled	*Sterna anaethetus*			U	U
RSTE	Tern, Roseate	*Sterna dougallii*			U	U
ARTE	Tern, Arctic	*Sterna paradisaea*	C	C		U
COTE	Tern, Common	*Sterna hirundo*		C	C	
CATE	Tern, Caspian	*Sterna caspia*	R	C	C	C
FOTE	Tern, Forster's	*Sterna forsteri*		C	C	C
LETE	Tern, Least	*Sterna albifrons*		R	C	C
ROTE	Tern, Royal	*Sterna maxima*		U	C	C
ELTE	Tern, Elegant	*Sterna elegans*		C		
BLTE	Tern, Black	*Chilidonias niger*		R	C	C
ALTE	Tern, Aleutian	*Sterna aleutica*	C			
SATE	Tern, Sandwich	*Sterna sandvicensis*			C	C
GUTE	Tern, Gull-billed	*Sterna nilotica*			C	C
UCTE	Tern, unidentified "comic"	[Unid. Common or Arctic Tern]				
UNTE	Tern, unidentified	[Unidentified tern]				
BLSK	Skimmer, Black	*Rynchops niger*		R	C	C
COMU	Murre, Common	*Uria aalge*	C	C		
THMU	Murre, Thick-billed	*Uria lomvia*	C	U		
DOVE	Dovekie	*Alle alle*				C
RAZO	Razorbill	*Alca torda*				C
PIGT	Guillemot, Pigeon	*Cepphus columba*	C	C		C
BLGT	Guillemot, Black	*Cepphus grylle*	U			C
CAAU	Auklet, Cassin's	*Ptychoramphus aleuticus*	C	C		
RHAU	Auklet, Rhinoceros	*Cerorhinca monocerata*	C	C		
LEAU	Auklet, Least	*Aethia pusilla*	C	R		
PAAU	Auklet, Parakeet	*Cyclorrhynchus psittacula*	C	R		
CRAU	Auklet, Crested	*Aethia cristatella*	C	R		
WHAU	Auklet, Whiskered	*Aethia pygmaea*	C			
UNAU	Auklet, unidentified	[Unidentified auklet]				
MAMT	Murrelet, Marbled	*Brachyramphus marmoratus*	C	U		
ANMT	Murrelet, Ancient	*Synthliboramphus antiquum*	C	U		
KIMT	Murrelet, Kittlitz's	*Brachyramphus brevirostris*	C			
XAMT	Murrelet, Xantus'	*Endomychura hypoleuca*		U		
CRMT	Murrelet, Craveri's	*Endomychura craveri*		R		

Field Code	Common Name	Scientific Name	AK and B.C.	CA, OR, WA	Gulf of Mexico	Atlantic Coast
Seabirds (Continued)						
UNMT	Murrelet, unidentifed	[Unidentified murrelet]				
TUPU	Puffin, Tufted	*Lunda cirrhata*	C	C		
HOPU	Puffin, Horned	*Fratercula corniculata*	C	U		
ATPU	Puffin, Atlantic	*Fratercula arctica*				U
UNPU	Puffin, unidentified	[Unidentified puffin]				
UNAC	Alcid, unidentified	[Unidentified alcid]				
ULAC	Alcid, unidentified large	[Unidentified large alcid]				
USAC	Alcid, unidentified small	[Unidentified small alcid]				
UMAC	Alcid, unidentified medium	[Unidentified med. alcid]				
REPH	Phalarope, Red	*Phalaropus fulicarius*	C	C		U
RNPH	Phalarope, Red-necked	*Phalaropus lobatus*	C	C		C
WLPH	Phalarope, Wilson's	*Phalaropus tricolor*		R	R	U
UNPH	Phalarope, unidentified	*Phalaropus sp.*				
Shorebirds - Bays and Outer Coast						
UNSR	Shorebird, unidentified	[Unidentified shorebird]				
ULSB	Shorebird, unidentified large	[Unidentified large shorebird]				
UMSB	Shorebird, unidentified medium	[Unidentified med. shorebird]				
USSB	Shorebird, unidentified small	[Unidentified small shorebird]				
BLOY	Oystercatcher, Black	*Haemotopus bachmani*	C	C		
AMOY	Oystercatcher, American	*Haemotopus palliatus*		R	C	C
AMAV	Avocet, American	*Recurvirostra americana*		C	U	R
BNST	Stilt, Black-necked	*Himantopus mexicanus*		C	U	U
JACA	Jacana, Northern	*Jacana spinosa*			R	
BBPL	Plover, Black-bellied	*Squatarola squatarola*	C	C	C	C
KILL	Killdeer	*Charadrius vociferus*	C	C	C	C
EUDO	Dotterel, Eurasian	*Charadrius morinellus*	R			
SNPL	Plover, Snowy	*Charadrius alexandrinus*		U	U	
SEPL	Plover, Semipalmated	*Charadrius semipalmatus*	C	C	C	C
PIPL	Plover, Piping	*Charadrius melodus*			U	U
WIPL	Plover, Wilson's	*Charadrius wilsonia*			C	C
MGPL	Plover, Mongolian	*Charadrius mongolus*	R			
MOPL	Plover, Mountain	*Eupoda montana*		C		
PAGP	Golden-plover, Pacific	*Pluvialis dominica*	U	U		
AMGP	Golden-plover, American	*Pluvialis apricaria*	C	U	U	R
LBCU	Curlew, Long-billed	*Numenius americanus*			C	U
BTCU	Curlew, Bristle-thighed	*Numenius tahitiensis*			C	U
WHIM	Whimbrel	*Numenius phaeopus*	C	C	U	C
BLAG	Godwit, Black-tailed	*Limosa limosa*	R			R
HUGO	Godwit, Hudsonian	*Limosa haemastica*	C	R		U
BARG	Godwit, Bar-tailed	*Limosa lapponica*	C	U		R
MAGO	Godwit, Marbled	*Limosa fedoa*		C	C	R
WILL	Willet	*Catoptrophorus semipalmatus*		C	C	C
WATA	Wandering Tattler	*Heteroscelus incanus*	C	U		
DUNL	Dunlin	*Calidris alpina*	C	C	C	C
WESA	Sandpiper, Western	*Calidris mauri*	C	C	U	R
SESA	Sandpiper, Semipalmated	*Calidris pusilla*	C	R	C	C
LESA	Sandpiper, Least	*Calidris minutilla*	C	C	C	C
ROSA	Sandpiper, Rock	*Calidris ptilocnemis*	U	U		
BASA	Sandpiper, Baird's	*Calidris bairdii*	C	U	U	U
PESA	Sandpiper, Pectoral	*Calidris melanotos*	C	U	C	C
SHAS	Sandpiper, Sharp-tailed	*Calidris acuminata*	R	R		
CUSA	Sandpiper, Curlew	*Calidris ferruginea*				R
WRSA	Sandpiper, White-rumped	*Calidris fuscicollis*			U	U
PUSA	Sandpiper, Purple	*Calidris maritima*				U
STSA	Sandpiper, Stilt	*Calidris himantopus*	U	R	U	U
RNST	Stint, Red-necked	*Calidris ruficollis*	R			
LIST	Stint, Little	*Calidris minuta*	R			R
LTST	Stint, Long-toed	*Calidris subminuta*	U			

Field Code	Common Name	Scientific Name	AK and B.C.	CA, OR, WA	Gulf of Mexico	Atlantic Coast
Shorebirds (Continued)						
UCSA	Unidentified *Calidris*	*Calidris sp.*				
SOSA	Sandpiper, Solitary	*Tringa solitaria*	C	R	C	C
WOSA	Sandpiper, Wood	*Tringa glareola*	U			
COGR	Greenshank, Common	*Tringa nebularia*	R			
SPRE	Redshank, Spotted	*Tringa erythropus*	R			
GRYE	Yellowlegs, Greater	*Tringa melanoleuca*	C	C	C	C
LEYE	Yellowlegs, Lesser	*Tringa flavipes*	U	U	C	C
COSA	Sandpiper, Common	*Actitis hypoleucos*	R			
SPSA	Sandpiper, Spotted	*Actitis macularia*	C	C	C	C
UPSA	Sandpiper, Upland	*Bartramia longicauda*	R	R	R	R
BBSA	Sandpiper, Buff-breasted	*Tryngites subruficollis*		R		U
UNSA	Sandpiper, unidentified	[Unidentified sandpiper]				
UNDO	Dowitcher, unidentified	*Limnodromus sp.*				
SBDO	Dowitcher, Short-billed	*Limnodromus griseus*	C	C	C	C
LBDO	Dowitcher, Long-billed	*Limnodromus scolopaceus*	C	C	C	U
SURF	Surfbird	*Aphriza virgata*	C	C		
RUTU	Turnstone, Ruddy	*Arenaria interpres*	C	C	C	C
BLTU	Turnstone, Black	*Arenaria melancephala*	C	C		
UNTU	Turnstone, unidentified	*Arenaria sp.*				
RDKT	Red Knot	*Calidris canutus*	U	U	U	C
SAND	Sanderling	*Calidris alba*	C	C	C	C
COSN	Snipe, Common	*Gallinago gallinago*	C	C	C	C
AMWO	American Woodcock	*Philohela minor*			C	C
Ducks, Geese, Swans (Bays and Estuaries)						
UNAS	Anas duck, unidentified	[Unidentified Anas duck]				
COEI	Eider, Common	*Somateria mollissima*	C	R		C
KIEI	Eider, King	*Somateria spectabilis*	U	R		R
SPEI	Eider, Spectacled	*Lampronetta fischeri*	U			
STEI	Eider, Steller's	*Polysticta stelleri*	U			
SUSC	Scoter, Surf	*Melanitta perspicillata*	C	C	C	
WWSC	Scoter, White-winged	*Melanitta fusca*	C	C	C	
BLSC	Scoter, Black	*Melanitta nigra*	C	U	C	
UNSC	Scoter, unidentified	*Melanitta sp.*				
MALL	Mallard	*Anas platyrhynchos*	C	C	C	C
NOPI	Pintail, Northern	*Anas acuta*	C	C	C	C
WHIP	Pintail, White-cheeked	*Anas bahamensis*				R
WIDU	Widgeon, American	*Anas americana*	C	C	C	C
EUDU	Wigeon, Eurasian	*Anas penelope*	U	R		R
GDWL	Gadwall	*Anas strepera*	U	C	C	C
SHDU	Shoveler, Northern	*Anas clypeata*	C	C	C	C
GARG	Garganey	*Anas querquedula*	R			
MODU	Duck, Mottled	*Anas fulgivula*			C	U
ABDU	Duck, American Black	*Anas rubripes*			C	C
GTTE	Green-winged Teal	*Anas carolinensis*	C	C	C	C
BWTE	Blue-winged Teal	*Anas discors*	U	U	C	C
CITE	Cinnamon Teal	*Anas cyanoptera*	R	C		
CADU	Canvasback	*Aythya valisneria*	U	C	C	C
RNDU	Duck, Ring-necked	*Aythya collaris*	C	C	C	C
RDHD	Redhead	*Aythya americana*	U	C	C	C
TUDU	Duck, Tufted	*Aythya fuligula*	R	R		R
GSDU	Scaup, Greater	*Aythya marila*	C	C	U	C
USDU	Scaup, Lesser	*Aythya affinis*	C	C	C	C
SCAU	Scaup, unidentified	[Unidentified scaup]				
UNAY	Aythya duck, unidentified	*Aythya sp.*				
CGDU	Goldeneye, Common	*Bucephala clangula*	C	C	C	C
BGDU	Goldeneye, Barrow's	*Bucephala islandica*	U	C		U
BUDU	Duck, Bufflehead	*Bucephala albeola*	C	C	C	C
UNBU	Bucephala duck, unidentified	*Bucephala sp.*				

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Ducks, Geese, Swans (Continued)						
HRDU	Duck, Harlequin	*Histrionicus histrionicus*	C	C		U
RUDU	Duck, Ruddy	*Oxyura jamaicensis*	U	C	C	C
FWDU	Whistling-duck, Fulvous	*Dendrocygna bicolor*		U	C	U
BWDU	Whistling-duck, Black-bellied	*Dendrocygna autumnalis*			U	
RBME	Merganser, Red-breasted	*Mergus serrator*	C	C	C	C
COME	Merganser, Common	*Mergus merganser*	C	C	C	C
HOME	Merganser, Hooded	*Lophodytes cucullatus*	C	C	C	C
OLDU	Duck, Oldsquaw	*Clangula hyemalis*	C	U		C
WODU	Duck, Wood	*Aix sponsa*	U	C	C	C
UNDU	Duck, unidentified	[Unidentified duck]				
BRAN	Brant	*Branta nigricans*	C	C		
CAGO	Goose, Canada	*Branta canadensis*	C	C	C	C
GWGO	Goose, Greater White-fronted	*Anser albifrons*	C	C	C	R
SNGO	Goose, Snow	*Chen hyperborea*	C	C	C	C
ROGO	Goose, Ross'	*Chen rossii*	R	C	U	R
EMGO	Goose, Emperor	*Chen canagica*	C	R		
WHSW	Swan, Whooper	*Cygnus cygnus*	R			
TUSW	Swan, Tundra	*Cygnus columbianus*	C	C		C
TRUS	Swan, Trumpeter	*Cgynus buccinator*	U	U		R
Waders and Marsh Birds (Bays and Estuaries)						
REEG	Egret, Reddish	*Egretta rufescens*		R	U	
SNEG	Egret, Snowy	*Egretta thula*		C	C	C
CAEG	Egret, Cattle	*Bubulcus ibis*		U	C	C
GREG	Egret, Great	*Casmerodius albus*		C	C	C
UNEG	Egret, unidentified	[Unidentified egret]				
GBHE	Heron, Great Blue	*Ardea herodias*	C	C	C	C
LBHE	Heron, Little Blue	*Florida caerulea*		R	C	C
TCHE	Heron, Tri-colored	*Hydranassa tricolor*			C	C
GRHE	Heron, Green	*Butorides virescens*		U	C	C
BCNH	Black-crowned Night Heron	*Nycticorax nycticorax*		C	C	C
YCNH	Yellow-crowned Night Heron	*Nyctanassa violacea*		R	C	C
WOST	Stork, Wood	*Mycteria americana*		R	U	U
WFIB	Ibis, White-faced	*Plegadis chihi*		C	C	
GLIB	Ibis, Glossy	*Plegadis falcinellus*			C	C
WHIB	Ibis, White	*Eudocimus albus*		R	C	C
ROSP	Spoonbill, Roseate	*Ajaia ajaja*			U	R
GRFL	Flamingo, Greater	*Phoenicopterus ruber*			R	R
AMBI	American Bittern	*Botaurus lentiginosus*		U	U	U
LEBI	Least Bittern	*Ixobrychus exilis*		U	C	C
YERA	Rail, Yellow	*Coturnicops noveboracensis*		R	U	U
BLRA	Rail, Black	*Laterallus jamaicensis*		R	U	U
CLRA	Rail, Clapper	*Rallus longirostris*		R	C	C
VIRA	Rail, Virginia	*Rallus limicola*	U	C	C	C
KIRA	Rail, King	*Rallus elegans*			C	C
SORA	Sora	*Porzana carolina*	U	C	C	C
COMO	Moorhen, Common	*Gallinula chloropus*		C	C	C
PUGA	Gallinule, Purple	*Porphyrula martinica*			C	C
AMCO	Coot, American	*Fulica americana*		C	C	C
WHCR	Crane, Whooping	*Grus americana*			R	
SACR	Crane, Sandhill	*Grus canadensis*	C	C	U	U

Field Code	Common Name	Scientific Name	AK and B.C.	CA, OR, WA	Gulf of Mexico	Atlantic Coast
Hawks, Eagles, Vultures (Bays and Estuaries)						
(Osprey, Perigrines, and Eagles also on outer coast)						
OSPR	Osprey	*Pandion haliaetus*	U	U	C	C
BDEA	Bald Eagle	*Haliaeetus leucocephalus*	C	U	U	C
GOEA	Eagle, Golden	*Aquila chrysaetos*	R	R		R
CRCA	Caracara, Crested	*Polyborus plancus*			U	
KEHA	American Kestrel	*Falco sparverius*	C	C	C	C
MEHA	Merlin	*Falco columbarius*	U	U	U	U
GYRF	Gyrfalcon	*Falco rusticolus*	U	R		R
PEFA	Falcon, Perigrine	*Falco peregrinus*	U	R	U	U
PRFA	Falcon, Prairie	*Falco mexicanus*		U		
NOHA	Harrier, Northern	*Cirus cyaneus*	U	C	C	C
SHHA	Hawk, Sharp-shinned	*Accipeter striatus*	C	C	C	C
COHA	Hawk, Cooper's	*Accipeter cooperii*	U	U	C	C
RSHA	Hawk, Red-shouldered	*Buteo lineatus*		U	C	C
BRHA	Hawk, Broad-winged	*Buteo platypterus*			C	C
SWHA	Hawk, Swainson's	*Buteo swainsoni*	U	U		R
RTHA	Hawk, Red-tailed	*Buteo jamaicensis*	C	C	C	C
FEHA	Hawk, Ferruginous	*Buteo regalis*		U		
ROHA	Hawk, Rough-legged	*Buteo lagopus*	C	C		C
WTHA	Hawk, White-tailed	*Buteo albicaudatus*			R	
STHA	Hawk, Short-tailed	*Buteo brachyurus*			R	R
WTKI	Kite, White-tailed	*Elanus caeruleus*		C	R	
MIKI	Kite, Mississippi	*Ictinia mississippiensis*			C	R
STKI	Kite, Swallow-tailed	*Elanoides forficatus*			U	R
SNKI	Kite, Snail	*Rostrhamus sociabilis*				R
CACO	Condor, California	*Gymnogyps californianus*		R		
BLVU	Vulture, Black	*Coragyps atratus*			C	C
TUVU	Vulture, Turkey	*Cathartes aura*		C	C	C
Passerines and Land Birds						
TURK	Turkey, Wild	*Meleagris gallopavo*			C	C
NOBO	Bobwhite, Northern	*Colinus virginianus*			C	C
WCPI	Pigeon, White-crowned	*Columba leucocephala*			U	R
ZEDO	Dove, Zenaida	*Zenaida aurita*			R	R
COGD	Ground-Dove, Common	*Columbina passerina*			C	C
BBCU	Cuckoo, Black-billed	*Coccyzus erythropthalmus*			C	C
YBCU	Cuckoo, Yellow-billed	*Coccyzus americanus*		R	C	C
MACU	Cuckoo, Mangrove	*Coccyzus minor*			U	R
SBAN	Ani, Smooth-billed	*Crotophaga ani*			U	R
BAOW	Owl, Barn	*Tyto alba*	U	C	C	C
GHOW	Owl, Great Horned	*Bubo virginianus*	C	C	C	C
SNOW	Owl, Snowy	*Nyctea scandiaca*	U	R		R
BUOW	Owl, Burrowing	*Athene cunicularia*		C		R
BROW	Owl, Barred	*Strix varia*		R	C	C
LEOW	Owl, Long-eared	*Asio otus*	U	U	U	U
SEOW	Owl, Short-eared	*Asio flammeus*	C	C	C	C
NSOW	Owl, Northern Saw-whet	*Aegolius acadicus*	U	U	U	C
CWWW	Chuck-will's-widow	*Caprimulgus carolinensis*			C	C
WPPW	Whip-poor-will	*Caprimulgus vociferus*			C	C
CHSW	Swift, Chimney	*Chaetura pelagica*			C	C
VASW	Swift, Vaux's	*Chaetura vauxi*		C		
ANHU	Hummingbird, Anna's	*Calypte anna*		C		
RUHU	Hummingbird, Rufous	*Selasphorus rufus*	C	C		
ALHU	Hummingbird, Allen's	*Selasphorus sasin*		C		
BEKI	Kingfisher, Belted	*Ceryle alcyon*	C	C	C	C
LEWO	Woodpecker, Lewis's	*Melanerpes lewis*		C		
RBWO	Woodpecker, Red-bellied	*Melanerpes carolinus*			C	C
TBWO	Woodpecker, Yellow-bellied	*Sphyrapicus varius*			C	C
RBSA	Sapsucker, Red-breasted	*Sphyrapicus ruber*	C	C		

Field Code	Common Name	Scientific Name	AK and B.C.	CA, OR, WA	Gulf of Mexico	Atlantic Coast
Passerines and Land Birds (Continued)						
NUWO	Woodpecker, Nuttall's	*Picoides nuttallii*		C		
DOWO	Woodpecker, Downy	*Picoides pubescens*	C	C	C	C
HAWO	Woodpecker, Hairy	*Picoides villosus*	C	C	C	C
RCWO	Woodpecker, Red-cockaded	*Picoides borealis*			R	R
NOFL	Flicker, Northern	*Colaptes auratus*	C	C	C	C
PIWO	Woodpecker, Pileated	*Dryocopus pileatus*	U	C	C	C
YBFL	Flycatcher, Yellow-bellied	*Empidonax flaviventris*				C
ACFL	Flycatcher, Acadian	*Empidonax virescens*			C	C
ALFL	Flycatcher, Alder	*Empidonax alnorum*	C			C
WIFL	Flycatcher, Willow	*Empidonax traillii*		C		C
PSFL	Flycatcher, Pacific-slope	*Empidonax difficilis*	C	C		
BLPH	Phoebe, Black	*Sayornis nigricans*		C		
EAPH	Phoebe, Eastern	*Sayornis phoebe*			C	C
GCFL	Flycatcher, Great Crested	*Myiarchus crinitus*			C	C
EAKI	Kingbird, Eastern	*Tyrannus tyrannus*			C	C
GRKI	Kingbird, Gray	*Tyrannus dominicensis*			C	C
STFL	Flycatcher, Scissor-tailed	*Tyrannus forficatus*			R	R
LOSH	Shrike, Loggerhead	*Lanius ludovicianus*		C	C	U
WEVI	Vireo, White-eyed	*Vireo griseus*			C	C
BEVI	Vireo, Bell's	*Vireo bellii*		U	U	
YTVI	Vireo, Yellow-throated	*Vireo flavifrons*			C	C
HUVI	Vireo, Hutton's	*Vireo huttoni*		C		
PHVI	Vireo, Philadelphia	*Vireo philadelphicus*			U	U
WAVI	Vireo, Warbling	*Vireo gilvus*	C	C	C	C
REVI	Vireo, Red-eyed	*Vireo olivaceus*		U	C	C
BWVI	Vireo, Black-whiskered	*Vireo altiloquus*			U	U
GRJA	Jay, Gray	*Perisoreus canadensis*	C	C		C
STJA	Jay, Stellar's	*Cyanocitta stelleri*	C	C		
BBMA	Magpie, Black-billed	*Pica pica*	C	C		
AMCR	Crow, American	*Corvus brachyrhynchos*	U	C	C	C
NOCR	Crow, Northwestern	*Corvus caurinus*	C	C		
FICR	Crow, Fish	*Corvus ossifragus*			C	C
CORA	Raven, Common	*Corvus corax*	C	C		U
HOLA	Lark, Horned	*Eremophila alpestris*	C	C	C	C
PUMA	Matin, Purple	*Progne subis*	R	U	C	C
TRSW	Swallow, Tree	*Tachycineta bicolor*	C	C	C	C
VGSW	Swallow, Violet-green	*Tachycineta thalassina*	C	C		
NRSW	Swallow, Northern Rough-winged	*Stelgidopteryx serripennis*	U	C	C	C
BASW	Swallow, Bank	*Riparia riparia*	C	C		C
CLSW	Swallow, Cliff	*Petrochelidon pyrrhonota*	C	C		C
BNSW	Swallow, Barn	*Hirundo rustica*	C	C	C	C
CACH	Chickadee, Carolina	*Poecile carolinensis*			C	C
BCCH	Chickadee, Black-capped	*Peocile atricapillus*	C	C	C	C
CBCH	Chickadee, Chestnut-backed	*Poecile rufescens*	C	C		
TUTI	Titmouse, Tufted	*Baeolophus bicolor*			C	C
WBNU	Nuthatch, White-breasted	*Sitta carolinensis*	C	C	C	C
BHNU	Nuthatch, Brown-headed	*Sitta pusilla*			C	C
BRCR	Creeper, Brown	*Certhia americana*	C	C	C	C
CAWR	Wren, Carolina	*Thryothorus ludovicianus*			C	C
BEWR	Wren, Bewick's	*Thryomanes bewickii*		C	U	U
WIWR	Wren, Winter	*Troglodytes troglodytes*	C	C	C	C
SEWR	Wren, Sedge	*Cistothorus platensis*			C	C
MAWR	Wren, Marsh	*Cistothorus palustris*	U	C	C	C
ARWA	Warbler, Arctic	*Phylloscopus borealis*	C			
BLUE	Bluethroat	*Luscinia svecica*	C			
NOWH	Wheatear, Northern	*Oenanthe oenanthe*	C			
VEER	Verry	*Catharus fuscescens*				C
GCTH	Thrush, Gray-cheeked	*Catharus minimus*	C			U
SWTH	Thrush, Swainson's	*Catharus ustulatus*	C	C		U
WOTH	Thrush, Wood	*Hylocichla mustelina*			C	C

Field Code	Common Name	Scientific Name	AK and B.C.	CA, OR, WA	Gulf of Mexico	Atlantic Coast
Passerines and Land Birds (Continued)						
WREN	Wrentit	*Chamaea fasciata*		C		
GRCA	Catbird, Gray	*Dumetella carolinensis*			C	C
LBTH	Thrasher, Long-billed	*Toxostoma longirostre*			U	
YWAG	Wagtail, Yellow	*Motacilla flava*	C			
WHWA	Wagtail, White	*Motacilla alba*	R			
RTPI	Pipit, Red-throated	*Anthus cervinus*	R			
AMPI	Pipit, American	*Anthus rubescens*	C	C	C	C
NOPA	Parula, Northern	*Parula americana*			C	C
BAWA	Warbler, Bachman's	*Vermivora bachmanii*				R
YEWA	Warbler, Yellow	*Dendroica petechia*	C	C	C	C
MAWA	Warbler, Magnolia	*Dendroica magnolia*				C
BBWA	Warbler, Black-throated Blue	*Dendroica caerulescens*				C
YTWA	Warbler, Yellow-throated	*Dendroica dominica*			C	C
PRWA	Warbler, Prairie	*Dendroica discolor*			C	C
PAWA	Warbler, Palm	*Dendroica palmarum*		R	C	C
CEWA	Warbler, Cerulean	*Dendroica cerulea*			U	C
BWWA	Warbler, Black-and-white	*Mniotilta varia*			C	C
PYWA	Warbler, Prothonotary	*Protonotaria citrea*			C	C
SWWA	Warbler, Swainson's	*Limnothlypis swainsonii*			U	U
OVEN	Ovenbird	*Seirus aurocapillus*				C
NOWA	Waterthrush, Northern	*Seiurus noveboracensis*	C		C	C
LOWA	Waterthrush, Louisiana	*Seirus motacilla*			C	C
KEWA	Warbler, Kentucky	*Oporornis formosus*			C	C
COWA	Warbler, Connecticut	*Oporornis agilis*				C
MOWA	Warbler, Mourning	*Oporornis philadelphia*				C
MGWA	Warbler, MacGillivray's	*Oporornis tolmiei*	C	C		
COYE	Yellowthroat, Common	*Geothlypis trichas*	C	C	C	C
HOWA	Warbler, Hooded	*Wilsonia citrina*			C	C
WIWA	Warbler, Wilson's	*Wilsonia pusilla*	C	C		U
YBCH	Chat, Yellow-breasted	*Icteria virens*		C	C	C
SCTA	Tanager, Scarlet	*Pirange olivacea*				C
SASP	Sparrow, Savannah	*Passerculus sandwichensis*	C	C	C	C
HESP	Sparrow, Henslow's	*Ammodramus henslowii*			U	U
LCSP	Sparrow, Le Conte's	*Ammodramus leconteii*			C	
NSSP	Sparrow, Nelson's Sharp-tailed	*Ammodramus nalsoni*			C	C
SSSP	Sparrow, Saltmarsh Sharp-tailed	*Ammodramus caudacutus*			C	C
SESP	Sparrow, Seaside	*Ammodramus maritimus*			C	C
SOSP	Sparrow, Song	*Melospiza melodia*	C	C	C	C
LISP	Sparrow, Lincoln's	*Melospiza lincolnii*	C	C	C	C
SWSP	Sparrow, Swamp	*Melospiza georgiana*			C	C
LALO	Longspur, Lapland	*Calcarius lapponicus*	C	U		U
SMLO	Longspur, Smith's	*Calcarius pictus*	U			
SNBU	Bunting, Snow	*Plectrophenax nivalis*	C	U		U
MKBU	Bunting, McKay's	*Plectrophenax hyperboreus*	U			
RBGR	Grosbeak, Rose-breasted	*Pheucticus ludovicianus*				C
BHGR	Grosbeak, Black-headed	*Pheucticus melanocephalus*		C		
BOBO	Bobolink	*Dolichonyx oryzivorus*			C	C
RWBL	Blackbird, Red-winged	*Agelaius phoeniceus*	C	C	C	C
TCBL	Blackbird, Tri-colored	*Agelaius tricolor*		C		
YHBL	Blackbird, Yellow-headed	*Xanthocephalus xanthocephalus*	U	C		
BTGR	Grackle, Boat-tailed	*Quiscalus major*			C	C
GTGR	Grackle, Great-tailed	*Quiscalus mexicanus*			C	
BUOR	Oriole, Bullock's	*Icterus bullockii*		C		
ORCR	Oriole, Orchard	*Icterus spurius*			C	C
GCRF	Rosy-finch, Gray-crowned	*Leucosticte tephrocotis*	C			
PIGR	Grosbeak, Pine	*Pinicola enucleator*	C	U		U

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APPENDIX B

PARTIAL DIRECTORY OF AIRCRAFT SERVICES

APPENDIX B
PARTIAL DIRECTORY OF AIRCRAFT SERVICES
Verified June 1999

(Inclusion does not imply endorsement.)

ALASKA

(1) ER Aviation Center
6160 Carl Brady Dr.
Anchorage, AK 99502
(907) 243-6633

Three Twin Otters available, one (300 series) w/250 gal. internal tank for long range. This company would be suitable for extended flights from shore anywhere in Alaska, including the Beaufort Sea. Planes already set up for marine mammal surveys and computer links to GPS.

(2) Homer Air
2190 Kachemak Dr.
Homer, AK 99603
(907) 235-8591

One Cessna 172 and three Cessna 206, all four with fixed wings; One Britain-Norman Islander. Planes available for work around Cook Inlet and Katchemak Bay.

(3) Skagway Air
P.O. Box 357
Skagway, AK 99840
(907) 983-2218

One Islander available; covers SE Alaska.

CALIFORNIA

(1) Aspen Helicopter
2899 W Fifth St.
Oxnard, CA 93030
(805) 985-5416

Three Partenavias (two reciprocating & one turbine) available; have done seabird colony surveys for the USFWS and marine mammal surveys for NMFS. Ideal for work in central and southern California.

GULF STATES

(1) Sea Air Services
P.O. Box 3542
Houma, LA 70361
(504) 879-1538

Cessna 180, and Cessna 185, both on floats.

(2) Baton Rouge Air Charter
4490 Blanche Noys Ave.
Baton Rouge, LA 70811
(225) 358-0055

FORMS

(If one wishes to use Forms to facilitate uniform data gathering, these may need to be modified to fit the specific needs of the project.)

FORM 9.1

BIRD AND MARINE MAMMAL AERIAL SURVEY VARIABLES AND CODES

Variable	Type;width	Codes/units
1 OBSERVER NAME	Character;3	Use initials of observer: e.g., MLB
2 OBSERVER POSITION	Numeric;1	1= Front seat left 2= Front seat right 3= Center seat left 4= Center seat right 5= Aft seat left 6= Aft seat right
3 AIRCRAFT ALTITUDE	Numeric;4	Altitude in feet
4 DATE	Numeric;8	mmddyyyy
5 TIME	Numeric;6	Local; 24-hour clock hhmmss
6 TRANSECT LEG TYPE	Character;1	E= Effort O= Off effort
7 LEG FLAG	Numeric;1	1= Begin 2= End
8 VISIBILITY LEFT	Character;2	EX= Excellent VG= Very Good GO= Good FA= Fair PO= Poor MO= Mammal Observers Off
9 GLARE LEFT	Numeric;1	Percent of Glare: 0= none 1= <10% 2= 10-25% 3= 25-50% 4= 50-75% 5= 75-100%
10 VISIBILITY RIGHT	Character;2	(Same as above for VIS LEFT)
11 GLARE RIGHT	Numeric;1	(Same as above GLARE LEFT)
12 CLOUD COVER	Numeric;1	1= <10% 2= 10-25% 3= 25-50% 4= 50-75% 5= 75-100%

Variable	Type;width	Codes/units
13 WIND	Character;3	Direction from, degrees magnetic
14 SEA STATE	Character;2	Beaufort scale
15 LATDEG	Numeric;2	Latitude, degree
16 LATMIN	Numeric;2	Latitude, minute
17 LATSEC	Numeric;2	Latitude, second
18 LONGDEG	Numeric;3	Longitude, degree
19 LONGMIN	Numeric;2	Longitude, minute
20 LONGSEC	Numeric;2	Longitude, second
21 SPECIES CODE	Character;4	(See Appendix A)
22 NUMBER	Numeric;6	Number of animals counted
23 NEWBORNS	Numeric;3	Number of newborns in sighting; cetacean species only
24 MALES	Numeric;3	Number of adult males in sighting; cetacean species only
25 FEMALES	Numeric;3	Number of adult females in sighting; cetacean species only
26 AGE	Numeric;1	Seabirds and Pinnipeds: 0= not noted 1= adult 2= juvenile 3= young of the year 4= nest
27 SEX	Character;1	M= male F= female
28 PLUMAGE	Character;1	1= light phase 2= dark phase 3= intermediate 4= nest 5= winter 6= male 7= female

Variable	Type;width	Codes/units
29 ASSOCIATION	Character;2	1= cetacean 2= pinniped 3= bird 4= cetacean and bird 5= cetacean and pinniped 6= pinniped and bird 7= cetacean, bird, pinniped 8= fish (e.g., bait balls) 9= kelp 10= plankton 11= flotsam 12= oil 13= turtle 14= shark 15= sea otter 16= color change/convergence 17= slick/Langmuir cell
30 DIRECTION	Character;3	Direction of movement; degrees magnetic
31 GROUP	Character;1	Cetacean group formation: 1= ranked/chorus line 2= tightly grouped/discoidal 3= spread with subschools 4= spread with subgroups 5= scattered 6= linear or file 7= pod 8= singleton

Variable	Type;width	Codes/units
32 BEHAVIOR	Character;2	1= mammals- aerial 2= mammals- feeding 3= mammals- sexual 4= mammals- mother/young 5= mammals- synchronous dive 6= mammals- aggressive 7= mammals- bowriding 8= mammals- contact/play 9= mammals- rapid swimming 10= mammals- porpoising 11= mammals- milling 12= mammals- swimming 13= mammals- spy hop 14= mammals- breach 15= mammals- fluking 16= mammals- loafing/rafting 21= birds- flying 22= birds- swim/no feeding 23= birds- feeding/diving 24= birds- following ship 25= birds- associated w/nest 26= birds- standing, no nest 27= birds- (see data book) 28= birds- follow ship 29= birds- chasing
33 DECLINE	Character;2	Declination angle, nearest degree
34 PERPDIST	Character;4	Distance at right-angle to track line; unit= feet
35 DISTCODE	Character;1	Seabird distance code: 0= not noted 1= nearshore on aerial/ship 2= within 50 m 3= 50-150 m 4= 150-400 m 5= beyond transect bounds ("off-transect")

FORM 9.2

BIRD AND MARINE MAMMAL AERIAL SURVEY DATA FORM

INCIDENT ID:______________________________
SURVEY NUMBER:__________________________
Date: _____/_____/_____
month day year

Page_____of _______
Recorder__________________

Entry No.	Species Code	Count	Dec-line	Alt (ft.)	Obs	Pos	Time			Latitude		Longitude		Tran-sect No.	Effort Status	Flag	Sea State	Visibility		Glare	
							hr	min	sec	deg	dec. min	deg	dec. min					Lt	Rt	Lt	Rt

Form 9.3

BIRD AERIAL SURVEY DATA FORM

INCIDENT ID:____________________
SURVEY NUMBER:_______________
Date: ______/_____/_____
month day year

Page_____**of**_____
Recorder_________________

					Weather Conditions								Species Data							
OBS DATE	TIME	LAT	LON	ON_OFF	CLOUD COVER	WIND KNOTS	WIND DIR	BEAUFORT	SWELL HEIGHT	SWELL DIR	TEMP	SPECIES	COUNT	BEHAVIOR	BIRD DIR	ACCOUNT	AGE	PLUMAGE	COMMENT

FORM 9.3 TABLE KEY

Field	Description
OBS DATE	Date of observation
TIME	Time of observation (generally in military)
LAT	Latitudinal location of observation
LON	Longitudinal location of observation
ON_OFF	Was the observation taken on or off transect? Y = Yes N = No
CLOUD COVER	Percent of sky covered by clouds
WIND KNOTS	Speed of wind in knots
WIND DIR	Direction wind is blowing
BEAUFORT	Beaufort sea state
SWELL HEIGHT	Height of swells on sea
SWELL DIR	Direction swells are moving
TEMP	Outside air temperature
SPECIES	Species observed
COUNT	Number of individuals of that species observed
BEHAVIOR	Behavior of the individuals: S = Swimming D = Diving FL = Flying R = Resting F = Feeding
BIRD DIR	Direction the individuals are moving: N = North NE = Northeast E = East SE = Southeast S = South SW = Southwest W = West NW = Northwest

Field	Description
ACCOUNT	Bird association with other objects/individuals: B = Boat S = Other bird species M = Other mammal species P = Plane
AGE	Age of the individuals: J = Juvenile I = Immature S = Sub-adult A = Adult
PLUMAGE	Plumage of the individuals: M = Molting O = Other, see comments
COMMENT	Observer's comments

FORM 9.4

BEACH SEARCH EFFORT

Who filled out this form?: _____
(name & affiliation)

SEARCH INFORMATION

Date:_____ **Beach Name or ID:**_____

Start Time: _____ **End Time:**_____

Searchers (last name, initial):
1, _____ 4, _____ 7, _____
2, _____ 5, _____ 8, _____
3, _____ 6, _____ 9, _____

ASSOCIATED DATA

Map Reference:_____ **Film (identify roll numbers):** _____

Live Birds/Mammals (include numbers, species, disposition): _____
_____

Dead Birds/Mammals (numbers): _____
(IMPORTANT: if none, put NONE)

List Tag Numbers Used:_____

INFORMATION ON BEACH SEARCHED:

Length of Beach Walked: From _____ to _____

Length:_____km / miles **Width:**_____ meters / yards

General Condition of Birds: No Oil Slightly Oiled Heavily Oiled Moussed

Beach Condition: No Oil Slightly Oiled Heavily Oiled Moussed

Substrate: Mud Sand Marsh Pebbles (diameter: _____)
Cobbles (diameter: _____) Rock Platform Other: _____

Dominant Color of Substrate: _____

GENERAL

State of Tide: _____ **Weather:** _____ **Visibility:** _____

FORM 9.5

BEACH CENSUS

Who filled out this form?: _____ **Page:** _____
(name & affiliation)

SEARCH INFORMATION

Date:_____ **Beach Name or ID:**_____

Start Time:_____ **End Time:**_____

Searchers (last name, initial):
1._____ 4._____ 7._____
2._____ 5._____ 8._____
3._____ 6._____ 9._____

ANIMALS FOUND: List one per line, use additional forms if necessary.

Tag Number	Species/ Taxon	Position on Beach				Oiled? (Y/N)	Scav? (Y/N)	Comments/ Disposition
		Below Wrack	On Wrack	Above Wrack	Back Beach			

NOTES
_____
_____
_____

FORM 9.5 TABLE KEY

Field	Description
Tag Number	The number on the tag you attach to the bird or mammal.
Species/Taxon	Species of the bird or mammal, or as specific an identification as can be made.
Position on Beach	Was the bird or mammal found: **Below** (seaward of) the wrackline? **On** the wrackline? **Above** (landward of) the wrackline? In the **Back Beach** (bluffs, dunes or grass beyond or above the tide line)?
Oiled? (Y/N)	Does the bird or mammal have oil on it? Yes or No.
Scav? (Y/N)	If a carcass, has it been scaveneged? Yes or No.
Comments/ Disposition	Comments on the condition of the bird or mammal. Is it dead or alive? If alive, describe its behavior.

Form 9.6

MORGUE RECORD

Tag ID Number:_____ **Examiner:**_____

Species:_____ **Date:**_____

Age Class:_____ **Page:**_____

Sex:_____ **Disposition:**_____

Degree of Decomposition	**Intactness of Carcass**	**Evidence of Scavenging**	**Degree of Oiling**	**Pattern of Oiling**
☐ Fresh	☐ Intact	☐ None	☐ None	☐ Entire Body
☐ Fur or feathers Sloughing	☐ Parts Only (specify below)	☐ Body Cavity Opened	☐ Unknown	☐ Dorsal Only
☐ Skin, Fur, Feathers, Bones	☐ Head	☐ Fresh Tissue on Bones	☐ < 2%	☐ Wings Only
NOTES:	☐ Wings	NOTES:	☐ 2-33%	☐ Dorsal and Ventral
	☐ Legs		☐ 33-66%	☐ Head
	☐ Feet		☐ > 66%	☐ Feet
	☐ Sternum		☐ Encased	☐ Other
	☐ Other		NOTES:	NOTES:
	NOTES:			

GENERAL NOTES: _____

FORM 9.6 TABLE KEY

Field	Description
Degree of Decomposition	Check the box which best describes how decomposed the carcass is.
Intactness of Carcass	Specify was parts of the carcass are still present. Check as many boxes as apply.
Evidence of Scavenging	Check the box which best describes the degree to which the carcass has been scavenged.
Degree of Oiling	Check the box which best describes the extent of oil on the carcass.
Pattern of Oiling	Describe what areas of the carcass the oil covers. Check as many boxes as apply.